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ABSTRACT

This document represents the proceedings of an international conference designed to highlight the urgent need for environmental education. Following the keynote addresses, 63 papers are presented in two sections. The section dealing with "Environmental Education" provides descriptions of environmental education programs in elementary schools, secondary schools, universities, and engineering institutions as well as non-formal educational facilities. The importance of field studies and demonstration projects is emphasized in several papers. The section on "Issues in Environmental Management" includes contributions on such topics as: (1) degradation of the environment resulting from development activities; (2) conservation needs; (3) illegal wildlife trade; (4) pesticide poisoning and treatment; (5) coastal zone management; (6) water pollution; (7) heritage conservation; (8) ecologically sustainable protein production; (9) management of forest resources; and (10) conservation of underexploited plant resources. Most of the papers deal specifically with India, although several presentations are about problems and programs in other nations. (TW)

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Environmental Education for Conservation and Development

(Proceedings of the Second International Conference on Environmental Education, New Delhi, 1985)

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INTRODUCTION

Desh Bandhu*

Environmental Education is a very broad subject. To quote from the recommendations ofthe First Intergovernmental Conference on Evironmental Education (Tbilisi 1977),

"A basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic and cultural aspects and acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving social problems, and in the management of the quality of the environment.

A further basic aim of environmental education is clearly to show the economic, political and ecological interdependence of the modern world in which decisions and actions by different countries can have international repercussions. Environmental education, should in this regard help to develop a sense of responsibility and solidarity among countries and regions as the foundations for a new international order which will guarantee the conservation and improvement of the environment."

It need not be emphasised again that the environment has to be considered in its totality to include the natural, man-made, technological and social (economic, political, cultural, historical and aesthetic) facets. Environmental education is a life-long continuing process and has to be imparted at all levels, formal and non-formal. Despite increased awareness of the environmental issues and concern over the deterioration of our environment, the human environment has only continued to show signs of further deterioration. Bhopal tragedy, Chernobyl disaster or the recent pollution of Rhine are only few examples of the serious situation faced by mankind today. If we cannot ensure that such events shall not occur again in future, the future of mankind shall remain uncertain. This requires not only to ensure incorporation of enough safeguards at the planning and execution phases of development projects, but environmental education at all levels. Every individual should be environmentally conscious and aware of his or her duties and responsibilities to safeguard the environment for today and tomorrow. Each individual must understand the possible environmental consequences of development projects. The decision makers (bureaucracy and the politicians) should understand and take into consideration environmental aspects in the developmental process and also appreciate the need for and values of conservation. Environmental education must provide for enough expertise at all levels for managing the natural resources in environmentally sound manner and at the same time to handle any unexpected environmental problem effectively and expeditiously.

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* *President, Indian Environmental Society, New Delhi*

The Second International Conference on Environmental Education brought together people from over 35 countries with a wide spectrum of background (social, cultural and economic) and experience in different fields of environment and environmental education. The contributions presented and discussed at the Conference covered an equally wide range of subjects: Many papers discussed environmental issues, degradation of environment resulting from developmental activities and conservation needs in different parts of the world to highlight the urgent need of environmental education. In several papers, environmental education programmes in primary and secondary schools,universities, engineering institutions and other non-formal education programmes were discussed. The importance of field studies and demonstration projects was brought out in some papers. The keynote speakers touched upon several important topics. The state of environmental education in India was reviewed by the Director of National Council of Educational Research and Training. Dr Asit Biswas summarised the global trends in environment today. The issues related to human settlements, the need for greater emphasis on non-conventional energy sources for betterment of our environment, and the importance of forests and wildlife were highlighted in other three addresses. Of special interest to the participants were the two exhaustive reports on state of environmental education and other environmental activities in India 's two neighbouring countries, Pakistan and Sri Lanka. Many other papers provide valuable material for thought and action. It is hoped that these papers shall stimulate ideas and further the cause of environmental education for a better future for the mankind.

DELHI DECLARATION ON ENVIRONMENTAL EDUCATION

The Conference adopted the following statement now known as Delhi Declaration on Environmental Education:

We the delegates to the Second International Conference on Environmental Education, held in New Delhi from March 4 to 9, 1985, under the auspices of the Indian Environmental Society and the Department of Environment, Government of India, and with the active support from the participation of a number of governmental and non-governmental agencies including the UN agencies, international organisations and representatives of 35 countries, took into account the efforts made during the Stockholm Conference (1972), followed by Belgrade Charter (1975), the Intergovernmental Conference at Tbilisi (1977) and the First Environmental Education Conference, New Delhi (1981), the International Workshop on Development and Biosphere Stability (New Delhi 1984) and the Banff Declaration of the North American Association for Environmental Education Strategies (1984), further took note of the following:

a. That it is no longer possible to divide human experience into separate economic and ecological entities. Massive starvation in Africa, technological disasters in Mexico and Bhopal, and threats of increasing pollution make it manbdatory for us to recognise and integrate the environmental dimensions as a must for sustainable development.

b. That the need of the poor, the greed of the rich and the careless application of technology are the major causes of environmental degradation which need to be addressed in an integrated and holistic manner as pointed out by Mrs Indira Gandhi at the UN Conference on Human Environment (1972).

c. That the deliberations of this conference, including the address delivered by the Vice-President of India and Minister of State for Environment, emphasised the need for environmental awareness as a pre-requisite for action and called upon individuals groups, communities, national governments and international bodies to promote the cause of environmental conservation.

d. That, environmental education and training should be an integral component of the educational process through formal and structured curricula as also through the non-formal media. This should aim at building professional manpower and an "environmentally literate" and active citizens,

e. That the majority of the population in developing countries is in the younger age group, and a sizeable number of them still remain outside the purview of a formal educational system. The potential capabilities of youth, children and womenfolk as stressed by Mr Rajiv Gandhi time and again should be introduced to the environmental conservation programme in the proposed revised Educational Policy.

2. Based on deliberations and consensus as arrived at the Conference, we urge upon all concerned for immediate action on the following recommendations:

a. Environmental education associations at the national level should be established to serve the professional needs of environmental educators, to create linkages with Governmental and non-governmental agencies, and to assist in development and dissemination of curriculum materials.

b. University teacher training programmes should incorporate training in environmental education. Only when environmental education assumes a central place in all education will it begin to influence environmental management and policy. Such training should include scientific and cultural strudies related to human activities and the environment.

c. Each nation should consider establishment of a Youth Environmental Corps consisting of Youth (age 16-22); the Corps would work on projects which promote ecologically sustainable development, especially in rural area. Youth Corps projects should provide environmental knowledge and skills for participants in the programme.

d. Environmental Education Councils composed of local residents, officials, farmers, teachers and businessmen and local bodies responsible for various environmentally related projects and programs should be established at the local level. Such Councils would serve in an advisory capacity to assist in implementation of programmes at the local level,

e. Environmental education demonstration projects should be established at the local level in concert with economic development projects to demonstrate the benefits of such a partnership. Such projects are necessary to gain local support for environmental education and to provide a working model for ecologically sustainable development.

f. Simple, easily applicable techniques should be developed for use by rural school teachers to demonstrate the practical importance of conserving nature.

g. Environmental educators must develop praction pedagogical methods which address problems of environmental health in daily life, e.g., clean drinking water, appropriate waste disposal, proper sanitatiom practices, as well as provide concepts and values regarding human environment rwelationships.

h. Environmental education curricula should be reviewed and where appropriate, revised to provide inclusion of scientific and cultural (humanities, politics, economics) content sufficient to ensure that students understand the scientific basis of environment and ecology and the organisation and processes of human societies. Without this scientific and cultural understanding, students are unable to develop a useful holistic perspective for effective citizenship and professional life,

i. Universities, educational and research and development institutions should be encouraged to generate new vistas of knowledge relating to environmental management in their respective areas of specialisation, and

j. The International Society for Environmental Education should establish a global Environmental Education communications system to disseminate information and monitor indicators of Biosphere's environmental quality such as soil erosion, freshwater availability, food production, energy utilization, population growth, pollution loading, rates of deforestation, rates of desertification and levels of soil salinisation.

THE STATE OF ENVIRONMENTAL EDUCATION IN INDIA

P. L. Malhotra*

Concern for the environment has been a part of India's social and cultural heritage. This land of ours is the birthplace of sages and of religions preaching love for every living thing, a concern for life and conservation of nature. India, of the bygone eras, was in a way the land of milk and honey, whose vast resources were exploited by many maurauders, and lastly she was colonized by the British. Post-Independence India has seen great achievements: on the one hand we have the Green Revolution ushering in an era of self-sufficiency in food, and on the other we have made giant strides in the utilization of resources, particularly petroleum, and in the development of industries. India today is a leader amongst developing countries. There is however a gloomier side to this picture.

- Our population is rising at a very high rate and is predicted to reach 1250 million by 2000 A.D.
- Total area under the threat of periodic floods has more than doubled in the last decade.
- The National Forest Policy Act, 1952 prescribed a minimum of 33% of the country's land area under forest cover, today there is only 12% and that too is fast depleting.
- More than 6000 million tonnes of the fertile topsoil are lost every year due to erosion.
- According to National Environmental Engineering Research Institute, Nagpur (NEERI), industries of Greater Bombay add about 1000 tonnes of pollutants to the atmosphere every day of which 38.4% is carbon monoxide and 34.4% is sulphur dioxide, rest particulates, ammonia and oxides of nitrogen.
- and of course, there is Bhopal- a tragedy which will linger in the minds of every conscious citizen of the world.

Our concern in this country is but a reflection of what is happening the world over. This concern found expression when UN convened the Conference on the Human Environment in Stockholm in 1972. Addressing the Plenary Session of the Conference, our late Prime Minister, Indira Gandhi said:

> "...one cannot be truly human and civilized unless one looks upon not only all fellowmen, but all nations with eyes of a friend.... Even though our industrial development is in its infancy and at its most difficult stage, we are

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Director, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 16, India

taking various steps to deal with the incipient environmental imbalances, moreso because of our concern for the human species which is also imperilled. In poverty he is threatened by malnutrition and disease, in weakness by war, in richness by pollution brought about by his own prosperity.. Environmental problems of the developing country are not a side effect of excessive industrialization but reflect the inadequacy of development. Life is one and the world is one and all these questions are interlinked. Population explosion, poverty, ignorance and disease, pollution of our surroundings, stockpiling of nuclear weapons and biological and chemical agents of destruction, are all parts of a vicious circle. Each is important and urgent.... The modern man must re -establish the unbroken link with nature and with life. He must again learn to invoke the energy of the growing things and to recognise as did the ancients in India, centuries ago, that one can take from the earth and atmosphere only so much as one puts back into them. In their hymn to earth, sages of the Atharva Veda chanted: I quote,

> "What of thee I dig out let that quickly grow over,
> let me not hit thy vital organs or thy heart."

It led the conference to proclaim "to defend and improve the environment for present and future generations." Subsequent developments such as the formation of UNEP, the Belgrade Charter (1975) and the Inter-Governmental Conference on Environmental Education, Tbilisi (1977) highlighted the role of education in the halting of destruction of the environment. If man is to survive he can only do so in harmony with nature. His superior brain has given him the power to mould the environment to his needs, to draw from the mother earth all he needs to sustain himself and his vagaries and luxuries. He has forgotten that he is but a very small part of this delicately balanced system, nature. Realization has come to him, hopefully, not too late. The lessons he has learnt the hard way must be passed on to the future generations.

Society expects the education system to build up environment-concious citizens. The necessity of environmental education, was voiced by the International Union of Conservation of Nature way back in the sixties and reiterated over the years in many conferences. We in India, may justly feel proud that our national documents, like the Report of the Education Commission (1964-66) and Curriculum for the Ten-year School: An Approach Paper (1975), all emphasize the need of environmental education. The present curricula of general education that is classes I-X, has in it, ample materials on the environment, its problems and conservation. But environmental education, to mind is not just awareness and knowledge, it is far more. It is development of proper attitudes, the awakening of the urge to make the world a better place to live in, to be aware of what is happening around and above all, to act without fear.

The formal education system has no doubt created awareness, but how far can a rigid examination-based system lead to the development of proper attitudes is a question that remains to be answered. If we could rid the formal education system out of the fetters of examination, take education out of the classroom and let the children indulge in activities suitable for the conservation of the environment, we would probably be building better citizens for the future.

We aim at universalization of education. To my mind literacy should not only be the three R's but also include environmental education. This need not be taught as separate subject but could be interwoven into the fabric of the three R's, thus enriching the design of the curricula. This sort of interweaving should be possible both for the formal and non-formal systems. A beginning has been made under the various UNICEF projects currently being conducted by NCERT. There are varied approaches which will be presented in another paper highlighting the NCERT activities in the field of environmental education. I hope that this will be discussed in this august body and that its deliberations will help us in imbibing more life into the primary curricula.

The general education upto class X should also be appraised in terms of making environment conscious citizens. While the curricula developed by NCERT have many environment-based concepts, the State syllabi lack much of it. Besides an environment-based, child-centered approach which is based on activities and projects is necessary for the inculcation of proper attitudes and values. However, once again the examination system has defeated the purpose of such curriculum designs. More stress is laid on the cognitive domain than on the pschyomotor or affective domains and hence learning becomes a drudgery. To my mind the only way out of this dilemma is the proper organisation of extra-curricular activities. Science clubs, drama, debates, painting competitions, all could highlight environmental issues, thus not only creating an awareness amongst peer groups but also amongst the parents. It is hoped that projects carried out under the aegis of science clubs would ultimately lead to the development of proper attitudes.

Such extra-curricular activities cannot be only the responsibility of the schools. Agencies, both voluntary and government, must come forward to help in this matter, through organising activities, giving expert advice and providing suitable information. It is rather sad that in this country where we have so much expertise, so many questions that arise in the minds of children remain unanswered for lack of communication between the young and the old. Is it not the time for the experts to step down from their ivory towers and to lead the future generation to better understanding of his natural, social and cultural environment?

The NCERT is going to set up a National Science Centre at New

Delhi as part of its Silver Jubilee Celebrations, 1986. This centre with its broad scope of envisaged activities, exhibitions lectures, science clubs, teacher programmes, and innovations in terms of classroom experiments and kits will further the cause of environmental education by filling the lacunae between scientists, teachers and the younger generation. It will be, I hope, a centre for dissemination of information for not only the educational community within India but also those from abroad and thus hlep improvement of science education in general and environmental education in particular.

I would like to tell you at this stage about another exciting programme which has been launched last year. It is called "Reading to Learn." Our children are starved of proper and attractive reading materials, and thus do not develop the habit of reading. Inculcation of such good reading habits lends to continuing education through life. We are proposing to bring out low priced reading kits, which will highlight current issues like deforestation, pollution, conservation of wild life, equality of sexes. For the elementary level these will be read aloud by the teachers. We hope these kits will lay the foundation for environment consciousness and the urge to improve the quality of life.

This brings us to the key-question of the training of teachers. Teachers play the pivotal role in conveying the underlying message of the curricula, and in the development of proper attitudes. However, if the teachers do not have proper understanding about the topics they teach or the attitudes that require to be inculcated in their pupils, they will fail to realize its educational objectives. Our teachers, therefore, need to be informed about the goals of environmental education, and how to achieve them. They must also be made aware of the environmental problems that exist within this country and their solution so that they may face their classes with confidence. This is no mean task considering we have 13 lakhs primary teachers, 8 lakhs middle school teachers, 5.5 lakhs secondary teachers and 2.9 lakhs higher secondary teachers, and most of them without an adequate background of the natural environmeent its problems and conservation. This massive task can only be attempted if all types of organisations come forward to lend hand. NCERT has carried out much innovation in this area through its integrated B.Sc., B.Ed courses, and M.Sc.Ed (Life Science) course. The curricula of both have recently been revitalized to emphasize environmental aspects. Several in-service courses are being organised for various levels. However,, much more needs to be done. The governmental and voluntary agencies could also play a key role in teacher training and teacher updating.

The communication satellite and ETV are also going to be a boon for the environmental educationist. Mass media has an appeal to both old and young. Usually children pick up much more from the media than from their teacher. To make ETV a real instrument of change, the programmes need to be specific as well as attractive, so that they draw the attention to local problems and also advise what actions are possible to overcome these drawbacks. It can thus not only enlighten the community but also point the way towards action. NCERT has started preparing ETV programmes, however such programmes need a lot of back-up support from other agencies both during their development and during their use. The follow-up action needs the cooperation of all types organization, so that the programme can have a real massive impact.

This gathering, where representation from many and different types of organisations from India and abroad, will, I hope, deliberate at length on the strategies of implementation of environmental education programmes so that we prepare action-oriented citizens who will work for the conservation of the environment.

NON-CONVENTIONAL ENERGY SOURCES FOR ENVIRONMENT PROTECTION

Maheshwar Dayal*

ENVIRONMENT AND HUMAN DEVELOPMENT

Man lives on earth. A deep relationship exists between the environment on earth and his life. The main factors of environment are Biological and Physical. The physical environment consists of land, water and air, bio-sphere provides the food and other requirements of man. Environment creates favourable conditions for the existence and development of different creatures. As a noted author has said:

> " The great numbers of living species on earth, hundreds of thousands of kinds of animals and plants, are arranged over the planet, not at random, but in organised and structured communities of living things... Each community is distinct. The species within each are tied together, in intricate net works of energy-flow or pathways of chemical raw materials from soil, air, and water; through various plants to various animals .... Disturbance of any part of a community affects all parts "

The ecosystems are essentially self-regenerating and self-sustainable in which different components are interconnected, interrelated and interdependent. "There is no waste in a natural scheme of things, as the waste of one species becomes food for another. The only external input is the sunlight". But the considerable waste generated by the human species caused environmental degradation; this throws the life support system out of gear. Our planet is a vast civilization reserve which needs to be conserved as a whole at all cost.

The level of economic development and distribution of population of any region depends on the relationship between man and the environment around him, different elements of which are used for different requirements. Land is used for meeting the food and raw material supplies. Water is used for irrigation and power generation. The use of all these elements should be made while keeping the ecological balance.

**Secretary, Dept of Non-conventional Energy Sources, Government of India, New Delhi*

Present Scenario

The Indian environment has been viciously affected and destroyed in the last century due to unrestricted felling of the forests. The consequences of excessive deforestation are increasing floods, soil erosion, heavy siltation of dams built at an enormous expense, and changes in micro-climates; in other words, a progressive depletion of the country's ecological bank, driving it incessantly towards bankruptcy. Flood damages alone, it is estimated, now average about Rs. 1000 crores every year. What is worse in human terms is the increasing denial to a large section of the country's population of forest products like firewood, which are vital for human survival.

River water pollution in India has reached a point of crisis The Ganga river system has been converted into a network of cesspools and drains due to the effluents of industries and municipalities in the region. The water of many other rivers in India has been polluted by sewerage, industrial wastes and industrial effluents which have led to mass fish kills. The Ganga, despite its high self-purification capacity, is among India's most polluted rivers. Shockingly high levels of pollution exist along vast stretches of the Yamuna river. Everyday, its 48 km portion through Delhi picks up nearly 200 million litres of untreated sewage. Twenty million litres of industrial effluents including about half a million litres of DDT wastes enter the Yamuna in this stretch. From Delhi to Agra, the Yamuna water is unfit for drinking and bathing.

Air is a precious natural resource without which life cannot be sustained for more than a few minutes, yet the concern for clean air and protection of the atmosphere from damage by human activities is only a recent phenomenon. Human activities like industrial production, motor transport and domestic burning of fuels are adding large amount of harmful pollutants to the atmosphere, triggering off a host of global and regional environmental problems.

Air pollution reminds most people of high chimneys at factories belching out thick clouds of black smoke. The fact that old people, women and children face far more serious risks due to pollution from smoke inside their homes, is not even generally known.

There are nearly a million motor vehicles on the roads of India. The exhaust fumes they emit contain carbon monoxide, nitrogen oxides, hydrocarbons, aldehydes and lead-oxide. The black smoke emitted by diesel engines contains more particulates than the exhaust of petrol engines though other pollutants stated above are less. Carbon monoxide decreases the capacity of the blood to carry oxygen from the lungs to the tissues.

Destruction of forest-cover and trees for whatever purpose and reason, have serious repercussion and deep- rooted effect on the environment. The population explosion, poverty and resultant need for clearance of large extent of forests endangered irreplaceable life forms (plants and animals), and drive them to the threshold level of extinction. Our late Prime Minister, Smt. Indira Gandhi, had rightly observed:

> "The environment in which animals and plants become extinct is not safe for the human beings either."

According to the National Fuelwood Study Committee 1982, more than 4.5 million ha of forests are lost upto 1980 due to agricultural and other development activities. The fuelwood requirements which are well in excess of rate of reforestation and causing additional losses of forest cover at the rapid rate.

India adopted the National Air (Prevention and Control of Pollution) Act only in 1981. This act vests the authority in the Central and State Boards for Prevention and Control of Water Pollution set up under an Act of 1974. These Boards are preparing to lay down and enforce standards. The Indian Standards Institution (ISI) has proposed standards for ambient air quality in respect of sulphur dioxide and particulate matters. Sulphur dioxide concentration in ambient air shall not exceed 60 µg/m (0.023 ppm) as annual 24-hour arithmetic mean with 200 µg/m (0.080 ppm) not to exceed more than 2 percent of the time and not on two consecutive days in a year. The particulate matter in ambient air shall not exceed as 24 hours' annual arithmetic mean, 200 µg/Nm in coastal areas; 300 µg/Nm in inland areas, and 500 µg/Nm in northern areas.

Normal particulate concentrations vary from 150 to 100 µg/m , that observed in coastal areas being up to 150 µg/m , ranging upto 250 µg/m in inland areas and upto 500 µg/m in the northern areas (except during dust storms).

For emissions from thermal power plants, ISI has recommended for particulate matter limits ranging from 250 mg/Nm for new pulverized coal-fired boilers in urban areas to 1,000 mg/Nm for old stocker firing boilers. For sulphur dioxide, the recommended emission limits is 600 mg/J of energy produced.

One can see, even without these figures how much needs to be done. Smoking chimneys are the general order, both in our urban and rural areas. Furthermore, emissions from automobiles, buses and trucks are visibly polluting urban areas in particular, and, in growing measure, the rural areas. This kind of pollution can and must be curbed. Reasonable air quality can be achieved with relatively modest addition or improvement to equipment and by better maintenance of equipment. In fact, air pollution often results from incomplete combustion, and reducing emission will improve fuel efficiency. Thus, energy cost reduction and environmental quality can be had by the same action.

CONVENTIONAL ENERGY SOURCES AND ENVIRONMENTAL DEGRADATION

All forms of conventional energy sources viz. Coal, oil, hydro and nuclear have environmental ramifications. In coal-based energy plants (power and industrial boilers) the environment has to be taken into account at the extraction, transport and generation stages. In the open-cast mining of coal, rehabilitation of the land is feasible and its cost low relative to the value of the coal mined. A proper understanding of the need for such rehabilitation can ensure that it is invariably done and pre-planned.

A major problem with thermal power generation is that of air pollution by stock exhausts. It is necessary to lay down and enforce air quality standards. Setting of standards is difficult since scientific information about the effects of air pollution on human health is not adequate. In some countries standards have been relaxed. For example, the nitrogen oxide standard in Japan has been raised from 0.02 ppm to a range of 0.04 to 0.06 ppm because of a feeling that the latter levels may not be harmful to health whereas the cost of attaining the lower level would be extremely high. Similarly, in the USA, analysis of dose response data and costs of achieving more stringent standards has led to the raising of the standards from 0.08 ppm (8 hours' averaoe) to 0.12 ppm.

This brings us to the need for proper evaluation of benefits and costs, even though rough approximations may be possible. In some cases, damage or loss of benefits may greatly exceed pollution control cost and also be large by themselves. In other cases the cost of pollution control may be substantial and yet achieve little additional benefits. However, such analysis can at least provide a basis for the choice of technology.

Electrical energy generation by hydro-electric power plants is non-polluting, and uses a renewable source of energy. However, there are several problems associated with the construction of giant dams on natural waterways. The construction of such dams alters the downstream ecology as well as that in the lake area behind the dam. Huge areas get submerged, flora, fauna or any agricultural produce of this land get affected. People and towns in this area have to be removed and re-allocated, causing disturbance and sometime hardships. Again the time taken for such large schemes to fructify is usually quite long. For these reasons, increasing thought is now being given to supplement such large projects with more small size hydroprojects called mini-hydel or micro-hydel, which can be built on small streams and even on canals, without large dams.

Nuclear energy can be obtained both through fusion and the fission processes. Enormous amounts of energy is released from small quantities of fuel in both these processes e.g., one ton of Uranium can theoretically yield energy equivalent to about three million tonnes of coal. The problem of disposal ofthe radioactive wastes which create environmental problems and possibilities of accident leading to release of radio-activity have, however, caused concern and opposition in some quarters. Scientific work is continuing on both these aspects.

NON-CONVENTIONAL ENERGY SOURCES

The non-conventional sources of energy like solar, wind, biomass, etc., are of vital importance for the present situation of energy crisis in third world and for protection of environment. The non-conventional energy sources are non-polluting and non-exhausting in nature. The Department of Non-Conventional Energy Sources (DNES) programmes stress the creation and strengthening of indigenous scientific and technological efforts in this area, and also the need for creation of proper delivery systems and extension services and removal of non-technical constraints and institutional or cultural barriers that hamper the wide diffusion of mature non-polluting technologies. Besides a proper infrastructure there is the need for appropriate economic policies and fiscal incentives to encourage and provide back-up to scientific and technological advances in this area.

Non-Conventional energy technologies are ideally suited for decentralized or small-scale energy supply systems which are particularly relevant for India's rural agricultural economy. The Government has embarked upon a major well co-ordinated effort to harness and develop non-conventional energy sources. Although certain technologies were known, recent developments have broadened their applicability, reduced costs and improved efficiencies. Many technologies have reached the stage of maturity, that is, they can be applied economically in a commercial manner, and on a large scale, particularly in rural and remote areas. The approach paper to the Seventh Plan approved at the highest level, has included the development of non-conventional energy sources as one of the priority areas.

Biogas

Biogas is one of the most important components of renewable energy supplies today. A by-product of biogas is a very valuable enriched fertilizer. Its other benefits include reduction in demand for fuelwood, improvement in sanitation, reduction in the incidence of eye diseases among village women and easy and efficient cooking and thereby reducing the drudgery in women's life thus making their time available for creative and developmental activities. Versatility is one of the greatest merits of biogas. It can be used for cooking, lighting, or for generation of power. It can be produced from a large variety of materials ranging from cattle, human and agricultural wastes and water hyacinth to industrials effluents.

At present, there are already more than 276,000 family type biogas plants working in the Country. Computing an average size 4 cu.m gas per plant, these are producing 8 lakhs cu.m gas per day which is equivalent to 240 million cu.m gas per annum or 44 million litres of kerosene oil valued at about Rs. 26.5 crores per year. In this financial year alone 150,000 plants are being installed which will save about 600,000 t/yr of fuelwood equivalent and provide clean cooking conditions in villages throughout the country.

There are 14 crore households in this country. Nearly 80% of them use wood and/or cow dung for generating cooking energy. The Chulhas (stoves) which are used for this purpose are inefficient. It has been calculated that if the efficiency of traditional chulhas is raised by just 1% from the present level, it will result in annual saving of 4 million tonnes of wood. The Department has recently launched a programme for the demonstration and installation of improved chulhas which aims at setting up 5 lakh chulhas during the current plan period. These chulhas will have an efficiency of 15-25% as against the 2-10% efficiency of traditional chulhas. The potential impact of these chulhas can be easily imagined. The improved models are both portable and fixed and have been chosen with a view to acceptability in the user community as well as efficiency. It is proposed to launch a much more massive programme in this area in the Seventh Plan.

Solar Energy

That sun is the source of practically all energy on the earth need not be emphasized. It is however surprising how often we tend to forget this basic fact of life on this earth.

While biogas derives specific energy from the sun in an indirect complicated manner; involving many principles of microbiology, solar thermal, and solar photovoltaic devices and system make use of the sun in a more direct manner. At present in this country, solar thermal systems are available for large scale use in the following areas: water heating, air heating, air drying, water desalination and solar cooking. Temperatures upto 100°C are easily obtainable in these devices, depending on the system.

The Government has supported, financially and otherwise, a large number of solar heating systems in the country. For example, a solar water heating system of a capacity 60,000 litres has been completed recently at Lodhi Hotelin Delhi. A 30 tonnes multipurpose solar drier was commissioned recently in Kerala. A tea drying plant using solar energy and waste heat was installed recently at Tocklai in Assam. Similar plants for coffee and tobacco are under construction. Solar water heating systems have been installed in public and private industries all over the country. It is proposed to give a major thrust to all the solar energy systems during the current year, and spread them far and wide in the country during the seventh plan.

One of the most successful application of solar water heating is found in the textile industry. Lead was taken by a textile mill in Ahmedabad to be followed by number of other heating and drying systems to be installed in a big way in the next 2-3 years in hospitals, hotels, textile industries, tea industry, distilleries etc. Contrary to general feeling the solar heat/drying systems are cheap as compared to conventional systems. They are also easy to maintain.

Solar Photo-Voltaic Systems

Solar photovoltaic systems can convert the energy of the sun directly into electricity. This is a high technology area. There are some problems relating to the materials to be used as medium for such conversions and the percentage output of electricity as a function of the total solar radiation received. High level R&D efforts are going on in the country to solve these problems in a more effective manner. At present technologies are available to enable 9-11% output in terms of electricity as a function of the solar radiation received by the system. This may not sound very high, but it should be remembered that an ordinary incandescent bulb uses only about 3% of the energy it consumes. An internal combustion engine does not use more than 30% of the energy it consumes. Solar photovaltaic devices are at present expensive but the costs are expected to come down in the next 5-6 years. Even now these are quite competitive for remote areas and special locations. Solar photovoltaic systems are being used in the country for a variety of purposes including water pumping, street lighting, communication, powering television, radio sets etc.

The Department of non-conventional energy sources is running presently a National Solar Photovoltaic Energy Demonstration Programme achieve a production capacity of one MW (obtained) per year by Sept. 1985. By that time BHEL, Bangalore, would also attain a capacity of 250 KW (electricity) per year. It is proposed to give a major boost to the solar photovoltaic programme in the current year and make it a substantive contributor to rural electrification of remote villages in the 7th Plan. R&D in this area is proposed to be particularly emphasized including work on amorphous silicon cells and modules, ribbon silicon cells and modules, etc., so as to reduce the present high costs.

Wind Energy

Indian potential for harnessing wind energy is not as great as the size of the country would lead us to imagine. However, there are large coastal and other areas where wind energy can be usefully exploited for pumping water and electricity generation.

900 wind pumps have been installed under Demonstration Programme in the country by the department so far. It is expected that by the end of the current year more than 1,000 wind pumps installed. The Government provides handsome support to the wind pump user by bearing entire cost of the mechanical system, leaving the cost of civil work to be borne by the beneficiary. Extension programme for water pumping wind mills is proposed to be taken up shortly. In the seventh plan, the extension programme will be enlarged greatly.

Small capacity generators or Wind Energy Conversion System (WECS as they are called) have been developed in the country and are being field tested.

Indigenous manufacture of some low capacity systems may also start in the near future. Wind farms of upto 5 MW capacity are planned for the known windy locations in India. Wind monitoring stations and development of prototypes of medium sized wind generators will be taken up at a wind energy centre, being established by the Department and the CSIR.

Certain Government Departments like Railways and Posts and Telegraphs have made small but definite steps forward in the use of wind energy and solar energy in their installations.

Energy From Urban Wastes

A major thrust has been given to various programme for generation of energy from urban wastes. These programme include power generation through incineration, pyrolysis, landfills and generation of gas from sewage. The Prime Minister recently announced the setting up of a Central Ganga Authority, which will oversee the implementation of a plan aiming at providing the basic facilities of sewage treatment coupled with recovery systems for fuels and fertilizers, for major cities and towns like Calcutta, Allahabad, Varanasi, Kanpur, Patna, on the Ganga river system. Large-scale generation of biogas for production of power and or domestic fuel from sewage are proposed to taken up in these cities, other cities in different parts of the country will also be provided with this facility depending on financial allocation. Work on an experimental project for incineration of 300 milion tonnes of solid wastes per day and generation of 3.74 MW power has already been started in Delhi.

Energy Plantation, Power Generation and Environment

One of the important methods of insulating ther country against impending disaster is to take to the Photosynthetic Model of development through large-scale use of biomass, particularly firewood. Such an option, apart from meeting energy needs would help to restore the relationship between man and his environment. Therefore, a very massive tree plantation programme is necessary both for energy needs and overall eco-development. Prime Minister Shri Rajiv Gandhi in his first address to the nation declared the constitution of Wasteland Development Board to cover at least 5 million ha of wasteland annually. In our country, the shortfall in firewood production by 2000 AD has been estimated at 137 mill. tonnes, which would require 34 mill. ha of land, at about four oven-dry tonnes wood per ha/year, and a minimum annual outlay of Rs 500 crores for 17 years to be made good. Once such a programme is successful, dung and plant-based residue would be available as organic fertilizer and as industrial feed stock, respectively.

Among the renewable alternatives, solar energy, captured by the plants through the process of photosynthesis, is the most important, especially because photosynthesis is the key process in the life-support system of this planet. Furthermore, the plant-based energy systems are not only renewable but they remove carbon dioxide from the atmosphere before turning it back with no overall quantitative increase, as also help to contain environmental pollution. Photosynthesis is at the base of all biomass production and food chains. It converts physical energy into chemical energy and generates oxygen, the life sustaining gas. Whereas net photosynthesis uses only 0.1% of sunlight it produces organic matter of which only 10% accounts for the total energy used by mankind and only 0.5% accounts for the entire food requirement of the human race. Increase in photosynthetic efficiency automatically increases production of organic matter. Various types of biomass and/or bio-fuels available are: firewood, agricultural alcohol, vegetable oil, hydrocarbon plants, particularly those yielding rubber and petroleum like materials; fresh weeds, sewage-grown algae, algal hydrocarbons and biologically produced hydrogen using halobacteria, algae, Azolla and even higher plants. Every feedstock or bioconversion process has its own merits and demerits, and the different routes available to generate solid, liquid and gaseous fuels are: anaerobic and enzymatic digesting and thermochemical conversion.

Biomass may not be panacea for all our energy problems but it will, no doubt, help to reduce substantially our dependence on fossil fuels. Being socially and environmentally relevant, biomass enables us to keep our air, water and land clean, and manage our life support system in a sustained manner. Two things are needed: first, in view of our country being predominantly agricultural, a perceptible tilt in favour of plants and plant sciences in our planning process by adoption of the Photosynthetic Model of Development, and secondly, India has to be made increasingly greener. Among other things, such a model envisages revegetating the uncultivated half of India to make the country fresh and verdant. This would have distinct enviroinmental, social and economic benefits and will help in many ways.

The Department of Non-Conventional Energy Sources (DNES) has planned to set up a chain of Biomass Research Centres in the country. Intergradation of production, conversion, utilisation and conservation of woody biomass is an important feature of this programme. It has been proposed to covver 1.5 million ha of substandard soils under energy plantation during Seventh Five Year Plan (1985-90).

It has been estimated that about 1000 ha can generate about 3 MW of power, besides providing fuelwood or charcoal which can support the energy needs of a population of 125 to 150 families. In India, even if one-fifth of the estimated 80 million ha of barren and waste land can be covered by such a programme, a generation capacity of about 48,000 MW can be created, which is considerably more than the entire installed power capacity in the country today from all thermal, hydro and nuclear sources. Moreover, power from energy plantations could be made available from a number of decentralised installations to minimise transmission and distribution costs. This would also provide fuelwood and charcoal to meet cooking needs of the rural poor, provide green biomass cover in area zones and raise rural incomes. The investment cost for such projects could be only about Rs. 12,000 per KW.

According to a calculation, the cost of electricity produced in such a programme would be about Rs. 0.87 per kw hr. assuming capital costs of local generation of Rs. 12,000 per kw, fuelwood is priced at Rs. 50 per quintal, O&M costs as Rs. 0.10, an annual capacity factor of 0.60 and a rate of return of 0.12. If the fuel wood is priced at Rs. 25 per quintal (since it is available next to the power unit), the cost of electricity comes down to Rs. 0.62 per kw hr. This can be favourably compared to a cost of Rs. 0.96 per kw hr for electricity from a central power station, to a village having a load of 20 kw, and at a distance of 10 km from the grid; these costs increase to Rs 1.11 per kw hr at a distance of 20 km, and Rs. 1.26 per at a distance of 30 km from the grid. Thus power from energy plantations is a very promising option for substantial power needs.

Biomass Gasifier

Partial combustion of wood with air yields gaseous mixture capable of producing gas which can be burnt in boilers designed for liquid for gaseous combustion, and engines after purification. There are a veriety of applications where this technology has far-reaching impact particularly for irrigation, crop drying, dairies and chilling centres, rural electrification and sawmills.

Adequate supply of water is one of the major limitations to boost up food production of afforestation programmes. During 6th plan, it is envisaged to energise 25 lakhs irrigation wells. The energy for lift irrigation can be obtained only from firewood which implies emphasis on energy plantation. With fast-growing tree species irrigation can triple production to that obtained under rainfed conditions. The approach of combining biomass production and gasification will result in many benefits, viz. wasteland utilisation, energy supply and generation of employment potential. This would help the farmer to be energy-independent and free from shortage of diesel and electricity. Supply of water from tubewells will help in increasing yeild even in non-irrigated areas with poor and unreliable rainfall. There are many potential areas for its application but the success depends upon the development of small-scale gasifiers (5-20 hp) based on wood and agricutural residues available in the country.

Other Sources of Energy

Water can be used for power generation even from the low and ultra-low heads available in canals, flowing streams in hills, river slopes, small irrigation dams, etc. Research and Development and pilot programmes have been taken up by the Department in these areas. Work is also being carried out on improving the designs of hydrams and water mills. Ocean thermal gradient energy, wave and tidal energy are yet another potential sources for coming years. A feasibility report is being prepared for setting up a one megawatt ocean thermal energy conversions pilot plant in Lakshdeep island, which envisages production of power and aquaculture based on nutrient rich cold water, from the deep sea. Research and Development Projects on production, storage ana utilization of hydrogen energy geothermal based cold storage systems and fuel cells are also being taken up. Proto-types of 3- and 4-wheeler battery powered vehicle have been developed and are undergoing field performance tests.

ROLE OF ENVIRONMENTAL EDUCATION

The World Environment Day is observed every year on June 5 with a view to arousing the masses and bringing the environmental issues to the forefronts of thinking and planning and also to remember this mother earth; the only environment we have to take stock of its great capacity to assure all, of the lasting prosperity. The citizens role in environmental protection needs no special emphasis. The fight against environmental degradation is not the only concern of the scientists, engineers or government agencies: but to be readily effective; it has to be an issue of everybody's concern. Much of the success in environmental preservation in advanced nations, is due to intervention and involvement of enlightened citizen-action groups debating on public forums, environmental issues like felling trees, construction of dams and location of nuclear power plants. The recent controversy over the Silent Valley project and the 'CHIPCO-MOVEMENT' in Himalayas in India (Almora Hills) is a welcome sign of people's awareness. The role of students and rural women folk in the CHIPCO-MOVEMENT' is heartening. Environmental education to understand the intimate relationship between the quality of the environment and human well-being has an important role to play in the direction of preserving the environment and ensuring the quality of life.

During early eighties, environmental studies were introduced into school curricula in the country with tremendous enthusiasm with an objective of new approach to education. It was hoped that children would grow up with a keener awareness of their environment. NCERT published number of documents in 1975 on environmental education. It was also recommended that the child should also develop habits of cleanliness and healthful living and understanding of the proper sanitation and hygiene of its neighbourhood.

To promote the environmental education both formal and non-formal, there should be involvement of each and every human being on the continent. Children's literature should be produced bringing out various aspects of environmental problems. State-level symposia should be conducted in collaboration with the State Education Departments. Departments like Environment and Energy should form a small unit for monitoring progress. A team of experts should be charged with the responsibility of developing and producing creative Environmental Education material for countrywide use.

The Department of Non-Conventional Energy Sources has constituted a Committee on Education and Training of New and Renewable Energy Sources. The Committee will prepare the syllabi for training courses at the level of school, colleges and three I's to educate the use of new and renewable energy systems.

ROLE OF FOREST AND WILDLIFE EDUCATION IN ENVIRONMENTAL CONSERVATION

L.H.A. Rego*

THE ROLE OF FORESTS

The role of forests in environmental conservation as one of the most important components of the biosphere is well recognised. The forests are the largest, most complex and most self-perpetuating of all the ecosystems. From the point of view of flora and fauna they have the most diverse gene pool. It is in the forests that the natural regulatory processes excel, producing the most stable of all ecosystems. The forests therefore play a vital role in environmental conservation.

Our Hoary Conservation Tradition

The principle of conservation has all along been an integral part of the Indian ethos. This is borne out by our ancient scriptures and historical records. The best in Indian culture was born in the forests. The Aryan civilization was cradled in our forests and sour rishis who evolved the Hindu philosophy, lived in complete harmony with nature and meditated in the peace and serenity of the woods, to give us the supernal values and ideals through our ancient scriptures, the Vedas and the Upanishads. Their ashrams were an epitome of man living in close communion with nature, with the trees, birds and animals. "Ahimsa Paramodharma" is a basic tenet of our religion and philosophy. Lord Buddha describes the forests as "a peculiar organism of unlimited kindness and benevolence that makes no demands for its sustenance but extends protection to all beings, offering shade even to the man with the axe who destroys it." No wonder then, that Gautam sought the shelter of the Bodhi tree to become Buddha, the Light of Asia. The world's first recorded conservation measures were enacted in India during the third century B.C., in the days of Emperor Ashoka whose benevolence extended to all living beings. His edicts on stone, on nature conservation, . survive even today. There is now an acceptance of the idea of the oneness of life and of our earth. The survival of man is dependent on the survival of animal and plant life. The hoary tradition of our country in conservation continues even today and we have the inspiring example of the bishnoi community in Rajasthan, Haryana and Uttar

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Pradesh, dedicated to protecting our trees and wild animals. The recent 'chipko' movement which emanated from Chamoli, in the inner Himalayas, is another striking reflection of this concern in the minds of the people.

Forests as an Important Facet of Environment

The importance of forests in the welfare of makind cannot be over-emphasised. In whatever the forests fulfil, the touchstone and measure of their value is human weal and satisfaction. Late Shri K.M. Munshi defined its role beautifully in the words, "There is a balance on earth between air, water, soil and plant. Trees have a great place in the economy of nature. They hold up the mountains, cushion the rain and storms. They discipline the rivers and control the floods. They maintain the springs, they break the winds, they foster the birds. They keep the air cool and clean. They are the guardians of the perennial springs of water. They are the natural defenders of dust storms. They check erosion by wind and water and they preserve the fertility of the soil".

The future of mankind is inextricably linked with forests, both as a national resource and as the strength behind a healthy environment. The ecological perspective has to embrace diverse aspects ranging from sustenance linkages of the rural communities and the demands of a developing economy to the dictates of scientific management assuring sustainable utilisation of the national resource.

Nature has lavishly endowed our country with a rich biotic heritage, with nearly 5% of all known plant and animal species found on the earth. Oure flora and fauna include about 13,000 species of flowering plants, 30,000 species of insects, 10,500 species of molluscs and other invertebrates, 2000 species of fish, 140 species of amphibians, 420 species of reptiles, 1200 species of birds and 340 species of mammals, besides a vast variety of oceanic fauna. No other country in the world, area for area, excels India, in the variety of its biological reserves.

The Forest Crisis

Despite our rich and hoary tradition in nature conservation, and the need to preserve our forests inviolate, there have been many factors which have proved inimical. The grim reality is, India with as high as 15% of the human and 14% of the cattle population of the world, has barely 2% of forests of the globe. The enormous and relentless pressure on our diminishing forests is therefore at once manifest. Nevertheless, of late, there has been a general awakening to protect our forests, which are virtually under a seige. This awakening however has to be translated into reality. "One touch of nature, makes the whole world kin" says Shakespeare.

It would be pertinent to recall an apt observation by UNESCO on the "environment crisis", which is as follws:

> "Imperfect understanding of the natural mechanisms which make possible the maintenance of life on earth; disregard of the unintentional effects of technology, in particulalr, the various forms of pollution; poor management of the soil, forests and water; unbridled consumption of fossil fuels; uncontrolled urbanisation; the relegation of the rural population to a marginal position; and the crushing of traditional cultures - these are the most obvious and most frequent disadvantages of the change that is taking place in the relations between man and his environment."

In this context, we need to ponder, as to how we could achieve material progress, without impairing the environment. Our late Prime Minister Smt. Indira Gandhi, in her stirring address in 1972 at the United Nations Conference on Human Environment at Stockholm, advocated "Development without Destruction", as the cardinal principle of planning. Being sensitive to the harm that thoughtless and unimaginative economic development can cause to the environment, through reckless destruction of forests and the resulting problems of soil erosion and floods, she was perceptive to the supreme importance of conservation in planning. Like a seer, she drew upon the fountain of wisdom and insight, from our ancient culture, to rivet attention to nature being imperilled by despoilation.

Permanent Needs the Forests Fulfill

The following are the paramount needs of the country which the forests are required to fulfil:

- Maintenance of environmental stability through preserving and where necessary restoring the ecological balance that has been adversely disturbed by an insufficient appreciation of the role of forests and consequently their rapid depletion;

- Conservation of what remains of the natural heritage of the country through preserving the existing natural forests along with their vast variety of flora and fauna which represent the tremendous biological diversity and genetic resources of the country;

- Checking denudation and soil erosion in the catchment areas of rivers in the interests of soil and water conservation, the prevention of floods as well as droughts and for the control of the premature siltation of costly reservoirs;

- Checking erosion along treeless banks of rivers, in the hot and cold deserts of Thar and Ladakh and their environs; on large stretches of waste lands in the hilly and drier parts of the country; on areas denuded of vegetation by shifting cultivation and on barren sea shores;

- Safeguarding and sustaining the welfare of tribal communities which are alomst entirely dependent on the use of various forest resources; Generating productive employment for the large number of unemployed and under-employed people in the rural sector in programmes of afforestation of degraded lands, whether Government or privately owned, and the need for generating forest-based employment for rural artisans;

- Generating productive employment for the large number of unemployed and under-employed people in the rural sector in programmes of aforestation of degraded lands, whether Goivernment or privately owned, and the need for genrrating forest-based employment for rural artisans,

- Meeting rerquirements of fuelwood, fooder, minor forest produce and small timber for the rural and tribal populations primarily through the afforestation of all denuded and degraded lands, regardless of their classification;

- Eliminating the pressure of industry on natural forests through the afforestation of all denuded and degraded lands;

- Encouraging more efficient use of forest resources by all sectors of society;

- Providing amenities for recreation and conservation education in urban and rural environments; and

- Creating a people's movement for achieving these objectives.

KEY ISSUES OF HUMAN SETTLEMENTS IN INDIAN PERSPECTIVE

Bruno Dias Souza*

Modification of nature by man is a pre-requisite for creating human settlements. Unlike the abode of other animals, human habitat is the product of an intellectual process, which through history created civilizations. Nature and the constraints posed by it were interpreted according to the genius of people living in different climatic and geologic regions and locations. Depending on the ability to control the options, settlement morphology varied between places.

Modification of nature by man for building habitation, however, created no serious concern until the industrial revolution, because the process of production and consumption maintained a symbiotic relationship with nature. The process of recycling continued. Irretrievable consumption was of a low order compared to the earth's resources. The process of industrial production, the growing population and the disparity in development standards between various settlements have put the whole range of human beings and their settlements under threat.

Pollution of air, water and earth due to the unimaginative control over production process, and callous attitude towards safety has resulted in serious situation drawing world attention. The location of petrochemical refineries; fertiliser, pesticides, chemical and steel manufacturing units; power generation works in or around human settlements without due cognisance to their effect on life of human beings have created situations of serious hazard. The example of Bhopal tragedy readily comes to mind. But there are number of settlements in India which are highly polluted, such as Ahmedabad, Baroda, Calcutta, Bombay, etc. These large urban centres have attracted a disproportionate share of environmentally hazardous uses, which is turn attracted millions of job-seekers into their death trap.

The United Nations forecasts suggest that the urban population in the developing countries is likely to treble between 1970 and 2001. Out of the total urban population of the developing world, the share of India is likely to be between 20-25%, which alone is likely to be larger than the total population of most countries including USA and USSR. The rapidly diminishing land-man ratio demands employment generation in sectors other than

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Director, School of Planning and Architecture, New Delhi, India agriculture. In order to catch up with the demands of employment generation in other sectors, development of urban settlements is imperative. The historic lag in development created by the colonial exploitation needs to be made up in a few decades. Industrialisation in west took place over a span of centuries. Thus the effects of the ills of industrial process was ironed out to some extent. However, the rapid pace of development enjoined by India within a short span of time has resulted in untold misery. Slums have come up around employment centres, some of which produce toxic and poisonous wastes, endangering lives. The housing construction has not been able to keep pace with population influx, resulting in slums, squatter settlements and shanty towns. Although no conclusive study has been undertaken, it may be reasonably assumed that unplanned slums and squatter settlements outnumber planned housing. The evolving pattern of settlements and the structure of its distribution needs to respond to the national demand.

The growth of population by another 300 million and the need to develop employment in areas other than agriculture would demand a changed outlook in settlement planning. The traditional classification of town and country would no longer appear to be valid. If the present trends are any indication, the larger urban settlements are growing at a faster rate resulting in few pockets of human concentration. Cities like Bombay and Calcutta no longer stand for human excellence in its ability to shape nature but are pictures of abject misery. The misery inflicted by the ever increasing pull generated by such large centres at the expense of all other settlements in its influence region prevents growth of all other centres and creates a regional imbalance. Of 3265 urban centres in India only 12 are metropolises and of these only 2 are over 10 million population. But in another 15 years we may have 20 or more metropolises and 5 or 6 super metropolises. What kind of settlement pattern will it give? Will it provide for a vast country like India? Can we afford to distinguish between settlements only on the criterion of size class? Or do we have to look beyond the rather arbitrary classification into a more dynamic order of settlement pattern.

First of all, human settlements need to be treated as an asset, brought about by human reason and endeavour, and as such needs to be respected. Economic class, occupational pattern are products of various factors, and they need not be used as determinants. Interdependency of settlements should be accepted irrespective of size. This pattern of interdependency over a spatial frame should be the concern. To sustain the population judicious and innovative exploitation of the resources is imperative. The spread of resources vary from area to area, region to region. A set of settlements need to be treated as part of a resource region, and ecosystem. Population and activities need to be distributed in a way that it allows.exploitation of resources within the sustenance capacity of the ecosystem.

The key-word is sustainable development. Development can only be sustained when it keeps pace with the rising expectation of the population. Rise in expectation is synonymous to growth. Efficient public transport, and perhaps efficient personal transport cannot any more be denied by provision of more mundane options. Similarly the technological options available for enriching the quality of life are likely to be in greater preference. Rural population who constitute the majority are likely to demand same level of amenities and facilities as an urbanite. The distinction between rural and urban in terms of the standard of living must get blurred with time. Perhaps a fair distribution in the order of settlements is called for. While ordering the pattern of human settlements one should bear in mind that a compatibility between ecological balance and the technological options is ensured.

The doubling of urban population between the decades of 60's and 80's and the forecasted doubling of the urban population of 1980's by 2001 is likely to put a severe strain on the settlements. The NBO estimated in 1980 that there were a shortage of 4.6 million housing units in urban areas and 16.1 million in rural areas. The same study also estimated that 17.9% of the urban population lived in slums. The available housing stock is also of poor quality. 41.72% of the urban households live in one-room accommodation and 28.08% of them lived in two-room accommodation. The situation is worse in large urban centres.

In orderto accommodate the rising population in urban centres a massive programme of housing needs to be undertaken. But if we adopt 'standard housing' as a technique the cost figure would be between 1000 billion, which is well beyond the resource of the country. The availability of materials for construction of 'standard housing' would require rise in steel output by 3 to 7 times, bricks by 4 to 8 times, and would require consumption of 4.2 million acres of additional land for habitation purposes. Under the overwhelming circumstances can we continue to take traditional approach to solve the gigantic problem facing us.

The practice of planning for human settlements has been based on the British model of controlling development. But the essential difference between India and Britain is that the development in Britain is generated by pressure for development, and therefore, plan is needed to control over- or injurious development.

Whereas in India there is need to promote development to eradicate the imbalance in spatial distribution of population and settlements and also to ensure equity in the standard of development and living. In India the pressure for development is high where development is costly and socially injurious. The high level of private sector investment in large cities like Bombay, Calcutta, Delhi, etc. and investment in posh housing manifest the trend and attitude. Private capital is scarce in areas which need development to uplift them from the morass of poverty and backwardness.

Unfortunately the national planning objectives have poor spatial bias, and have not provided adequate guidance for spatial distribution of opportunities and facilities. There is urgent need to arrive at the spatial pattern in the distribution of settlements, order their hierarchy, assess their need and demand, and allocate resource on a programmed and co-ordinated basis.

While the spatial organisation of settlements have a low priority in national planning, the settlements are growing in an unplanned manner, consuming fertile land, destroying forests, creating problems of erosion of land, sitlation of of lakes and river beds in an unchecked orgy towards destruction. More vulnerable settlements are reaching a state where the existence of the settlement itself is threatened. Spatial planning concerns itself with the task of identifying on ground the area to be developed for various purposes. The characteristics of the land and its resources achieve their full dimension and the implications of investment decisions become apparent at the time of translation of a decision to reality. Decisions, however well intentioned, arrived at without considering the realities of space, land and its physical attributes, population and its societal structure, the interelationship between various settlements over land, create inefficiency. One of themain reasons of partial success of the Fiscal Planning has been its dissociation with spatial planning. To elaborate, a pesticides factory is necessary for increased food production. But merely the finance or knowhow of pesticides manufacture is not enough. The location, the microclimate, geology, hydrology, landuse pattern of the area are also serious concerns to be taken note of. When these are ignored, you end up with a tragedy like that of Bhopal. One could go on citing examples of non-spatial planning in this country, the consequence of which has been rather serious.

India is a country of historic cities. No other country can match India in historic rich heritage of settlement pattern. Yet it is an area which has received very little attention. All our ancient cities, some of which date back to more than thousand years, are today subject to destruction by the process of relentless unplanned development. Ancient cities like Hardwar, Pushkar, Jaisalmer, are wonders of architectural genious of people. Any other country would have taken great care to conserve them. Fortunately, the late Prime Minister Mrs. Indira Gandhi was and our present Prime Minister is alive to the issues of conserving the cultural and historic heritage. However, these settlements can be saved only by a totality of conservation approach, rather than by piecemeal efforts of preservation.

The School of Planning and Architecture, New Delhi, concerns itself with the task of training professionals in the field of spatial planning and physical development. Through courses in various disciplines, the students are trained to understand and appreciate the various facets of environmental issues. Case studies are undertaken of areas serious environmental concern and approapriate solutions are sought. The School has endeavoured to put up a small exhibition by drawing upon samples of work carried on in the School to provide some ideas of the nature of studies undertaken.

The exhibition tries to project the environmental problems faced by settlements such as Nainital, Pushkar and Bangalore, all of which are dependent on natural ecological balance for sustenance. The denudation of the resources by human activities such as defoerestation, building on unstable stopes, filling up of existing waterbodies for making more land available for settlements is resulting in danger of landslides, siltation of lake, drying up of water resources. Similarly the natural and man made environment suitable for settlement by other species of animal and plant life are being invaded by the human beings, thereby destroying the habitat and its environment. Man made built environments of historic cities like Hardwar and Jaisalmer are threatened by unsystematic development, thus slowly obliterating the heritage of thousands of years. These and many issues are projected in the exhibition.

The complex pattern of interaction between man and his settlement, needs of sustenance and the environment requires careful analysis and understanding. Unfortunately the education on the environmental issues is considered to be appropriate for the mature trained mind. From the very ancient times however, the societal behaviour pattern was in harmony with the environment and every man knew his relationship with nature and respected it. It is necessary that the same kind of tatent understanding is brough about from a tender age. While the techniques of control and prevention require mature technologist, the environmental deterioration is not entirely the products of unplanned development alone. Our cities look dismal because of the attitude of the inhabitants who care very little. Garbage is littered all over the place, buildings are not painted, public transports are not cleaned regularly. Simple sense of hygiene could provide us with a cleaner environment. Whereas average Indian has a sense of personal cleanliness, he is generally careless about environmental hygience which affects the community. There is need to bring about greater awareness of community hygiene and inculcate this sense from the early childhood. The education system has a role to play in this regard.

Similarly the sense of aesthetics is a product of environmental concern. Sense of aesthetics is a cultivated art. Villages in some parts of India are rich in aesthetic quality which is a product of the live concern of the people living there. But the city, is an anonymous agglomeration of people who do not share the same concern for the aesthetic environment. Therefore the educational process has a definite role to play in developing the aesthetic sense in people living in urban area.

In the end I would like to conclude by identifying a few major areas of concern which are as the following:

1. There is need to recognise settlements within a spatial frame of ecology, resource, manpower and opportunities and order their growth through planned intervention and financial assistance to encourage and achieve a rational distribution of population, facilitties and amenities, and employment. The national planning must seriously concernitself with spatial allocation ofresources.

2. In doing so the sustenance capacity of the environment of every settlement for supporting optimal population and activities, level of maintenance and conservation of resources need to be taken special note of. It is also very important to give due weightage to the rising expectations for a higher standard of living. No planing in a developing country can succeed without matching the expectations with achievement.

3. Environmental education need to be given priority from a tender age i.e. at the level of elementary schools. The present educational system has some bias towards environmental education, but this needs to be enlarged. Professional courses, however, has to be re-oriented to provide a far greater bias towards the understanding of environmental issues, impart training to adequately deel with environmental problem. Institutions which are in a position to impart such training needs encouragement and support.

GLOBAL ENVIRONMENTAL TRENDS

Margaret R. Biswas* and Asit K. Biswas**

Slightly more than a decade ago, in June 1972, the United Nations convened a major intergovernmental conference on the Human Environment at Stockholm, Sweden. It was undoubtedly the most important environmental event of an international character that took place during the past two decades and to a great extent set into motion a process through which international issues and concerns were to be discussed, reviewed and analysed.

When the Stockholm Conference was first proposed by Sweden in 1968, the industrialized countries in general reacted favourably. This is not surprising since interest in environmental issues in those countries was high. The activities of numerous citizens' groups and non-governmental organizations continually focussed the attention of the general public and politicians to deteriorating environmental situations. Many groups took the streets to protest, and especially in the United States, environment and Vietnam became two of the major issues with which the youth rebelled against the establishment. These pressure groups and several scientists started to publicise critical and emerging environmental issues, some real and others not so. At the crest of the environment movement, the Earth Day attracted an estimated 20 million participants in the United States alone.

In contrast to the favourable disposition of the indutrialised countries, the reactions of developing countries to the Stockholm Conference when it was first announced, were mixed, and the favourable reactions were lukewarm at best (Biswas and Biswas 1982). Interest in the environmental concerns were not as high as in the West, and there was a general feeling that the environmental problems were less of a priority compared to the real problems facing them, alleviation of poverty.

By the time the Stockholm Conference took place, many of the initial concerns asnd doubts expressed by developing countries were alleviated sufficiently for them to participate in the gathering. This turned out to be fortuitous since the Soviet Union and the rest of the Eastern Block of nations (with the exception of Romania) did not take part because of the conflict over the status of East Germany. Eventually 113 nations participated.

The Stockholm Conference agreed on a Declaration and an Action Plan. The Declaration consisted of a Proclamation and 26

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principles. The proclamation was somewhat general and put man firmly as the central focus of any equation by stating categorically that "of all things in the world, people are the most precious".

The Conference undoubtedly raised the environmental consciousness of the world and sensitized public opinion. The Confernce itself and the simultaneous Environmental Forum, organized by environmental pressure groups and other non-governmental organizations, together constituted one of the largest international gatherings ever held.

Looking back, more than a decade later, the Stockholm Conference appears to have been more of a success than many realized at that time. Its timing was right: it was held when the environmental movement in the West was at its peak, and developed countries were willing to provide funds for international environmental protection and management. It established an institutional machinery, United Nations Environment Programme (UNEP), as the environmental conscience of the UN system and also to look after the events following the Conference.

Many of the major environmental trends of the present and of the future, for example, ecological disturbances caused by the pursuit of short-term benefits in the development process, resource impoverishment, and environmental degradation as a result of population growth, are not new, but have long been recognised as serious problems. What is new, however, is the accelerating pace and scale of the problems. New, too, is the recognition of their interrelationships, which mean that they can be understood and dealt with only within the overall framework of the web of causes and effects that bind them together. It also means that they can not be resolved by further fine tuning of traditional responses. In this sense they are of a wholly new character and require not only better understanding and development of new attitudes and perceptions, but also new modes of management responses, a fact that was clearly recognised at the Stockholm Conference.

The various environmental issues will be discussed herein under three broad categories: interrelationships between people, resources, environment and development; rational use of natural resources; and new patterns of development and life-styles. These categories, however, are not discrete: they too are interrelated.

PEOPLE-RESOURCES-ENVIRONMENT-DEVELOPMENT

An analysis of the report of the United Nations Conference on the Human Environment (Anon. 1973) will indicate that though there was reasonable understanding at that time of the interrelationships between population, resources, environment and development, the approaches adopted in the resolutions were basically sectoral. Since that Conference, however, our understanding of the development processes has been enhanced greatly. This, to a certain extent, was facilitated by the holding of subsequent major United Nations World Conferences on Population (Bucharest 1974) Food (Rome 1974), Human Settlements (Vancouver 1976), Water (Mar del Plata 1977), Desertification (Nairobi 1977), Science and Technology for Development (Vienna) and New and Renewable Sources of Energy (Nairobi 1981) (M.R. Biswas 1974, 1975, 1977, 1978 a,b, 1981). Through the preparatory processes undertaken for these conferences as well as through the discussions during the conferences and the subsequent implementation of their recommendations, man's understanding of the complexities of development processes has evolved further. For example, it is now better recognized that development is a multidimensional concept which encompasses not only economic and social activities, but also those related to population, the use of natural resources, and their resulting impacts on the environment (Tolba 1982).

While the interrelationships concept is not novel, the need for rapid development and technological advancement has meant that, very often, whatever knowledge of interrelationships was available tended to be disregarded. However, attempts to solve seemingly technical problems such as desertification, loss of productive soil or deforestation have indicated that emphasis should be placed not only on such physical factors as climate, soil type, modes of cultivation or land-use patterns, but also on diverse factors including demographic trends, types of technology used, levels and distribution of income among the population, consumption patterns, cultural habits and educational levels of the inhabitants, etc. Without such a holistic approach, actions taken to solve specific problems may give rise to several other unintended side-affects, the sum total of which could even be worse than the problems initially addressed. To some extent, this can be explained by the fact that the nature of beneficiaries often tend to be different. Much of the benefits of the original action tend to accrue to a more educated and powerful section of the population, whereas the adverse side-effects, to a large extent are borne by people who do not have a power base and as such as not in a position to influence the socio-economic decisions which affect their own lives and life-styles.

Population

While it may be difficult to forecast the future precisely, one fact is certain: world population will continue to increase for a few decades. The rate of population growth is unlikely to slow appreciably, and most of this growth will take place in developing countries, which will face challenging problems resulting from rapid urbanization. According to United Nations estimates, world population is expected to increase from about 4,415 million in 1980 to about 5,275 million in 1990. The population growth rate in developing countries will in all probability drop slightly from the 2.2% a year rate recorded in 1975, but even then, in absolute terms and using the slowest growth scenario of any international study carried out so far, the number of persons being added annually to the world's population will be significantly greater at the end of the decade than it is today. The past trend of increase in the share of developing countries in the world's population is likely to continue: from 66% in 1950 to 72% in 1975 and about 75% in 1990. The population growth rate in developed countries will in all probability decrease from the 0.7 percent rate observed in 1975. Because of better health care facilities, the present trend of life expectancies at birth in developing countries is expected to continue to increase. Similarly the migration of rural population to urban areas will continue during this period in both developed and developing countries.

While it is comparatively easy to make the general forecast of population trends, it is more difficult to predict many factors which influence population trends, i.e. fertility, life span, mortality, or migration. Information on population trends is one of the fundamental prerequisites for considering other major environmental trends since basic requirements for food, shelter, energy, mionerals, education, employment, etc. depend on population levels.

Interrelationships

Several studies were carried out during the past decade which attempted to relate population to resources availability, environmental degradation and development. Some studies, like the Limits to Growth (Meadows et al. 1972) model, predicted that both population and economic growth must cease by the year 2000, otherwise society would overshoot and collapse. Such studies are now generally discredited, however, since the models developed were simplistic, inadequate, based on faulty understanding of the probelms, limited or even faulty data and considered a very high level of aggregation. These models failed to reflect accurately the important interrelationships and continual feedbacks between people, resources, environment and development (A.K. Biswas 1979, 1982). What is necessary during the next decade is a more positive approach to development which adequately reflects these interrelationships. There is still a great potential to expand the ability of the global ecosystem to support more people, by judicious combination of making more productive and rational use of the earth's available resources and by a more equitable distribution of the benefits of various production processes (A.K. Biswas 1984). Since the carrying capacity of the earth is not infinite, development plans should take full advantage of the potentials but at the same time must be aware of the constraints imposed by the life-support systems.

The study of interrelationships between people, resources, environment and development is important for three major and interlinked reasons. First, it is increasingly evident that development efforts, at all stages of growth and in countries having different social, economic and cultural backgrounds, institutional infrastructures and availability of natural resources, tend to produce systemic effects at national, regional and global levels that have a cumulative impact on the overall productive process and the attainment of long-term development objectives. Second, it is also increasingly evident that such systemic effects result from strong interactions between economic, social, demographic and physical factors. Third, since the exact causal links between these interactions are at present unknown, there is considerable uncertainty with regard to the likely long-term impact of such systemic effects and, consequently, attention has largely focused on the risks of negative impacts, even though the probability of positive impacts is also quite high. Taken together, these three considerations suggest the need for a more constructive approach, emphasising that the study of interrelationships should clarify causal linkages and identify points of leverage so that appropriate integrated policies and programmes can be adopted to start a cycle of positive impacts in terms of attaining both developmental and environmental objectives, and ensuring that development can be sustainable over a long-term basis.

The critical issues are not so much the rate of population growth and the insufficiency or the unavailability of natural resources, but rather the uneven geographical distribution of population relative to the carrying capacity of land and the inefficient and irrational use of natural resources. Consideration of these fundamental issues broadens the scope of analysis from resource depletion, environmental degradation and population growth to include resource redistribution and transfer, environmental management that encourages more rational use of resources, development of appropriate technologies, and population movement. Environmental management of this kind would require better understanding and co-operation among, as well as within, nations, since ultimately the interrelationships between the four areas frequently extend beyond national boundaries. In the final analysis, the problem of interrelationships becomes a collective responsibility of the entire international community.

Many of the conceptual issues associated with the interrelations between people, resources, environment and development have been clarified during the 1970s and are undoubtedly better understood and more widely recognized at present than they were at the time of the Stockholm Conference. Understanding of the interrelationships is still incomplete, however, and much work remains to be done during the next decade to analyse the underlying complexities, identify their policy implications and use the resultant knowledge successfully in operational contexts, so that the development process can benefit from an integrated approach, rather than the sectoral approach which is all too common at present. Techniques and means will have to be developed not only for devising intersectoral policies and programmes at the national, regional and global levels, but also for ensuring their affective implementation. Such developments should finally lead to rational resources management and effective environmental protection. Major structural changes may be required, including resource transfers between nations to promote a more equitable sharing, development of alternative life-styles, and fundamental shifts in international economic relations.

RATIONAL USE OF NATURAL RESOURCES

Resources are the life-blood of any society and the development process is sustainable only if it is underpinned by the continued availabilty of natural resources. Availability of natural resources, however, is not enough: countries should be in a position to utilize them effectively, which in turn depends on their ability to apply technology, as well as on the availability of funds for capital investment. There are many countries at present which have a rich resources base, but are still underdeveloped due to their inability to apply technology to transform those resources and/or to lack of investment funds, a situation which is largely attributable to constraints imposed by social, economic and institutional structures both within and among the nations. During the next decade, attempts must be made to use the available natural resources successfully for further development, while at the same time ensuring that this foundation of the resource and environmental base on which development itself depends is not undermined.

Consumption of natural resources, both renewable and non-renewable, has increased in recent years. Developed countries consume the bulk of the world's natural resources, and irrational use patterns have greatly contributed to the deterioration of both the resource base and the quality aof the environment. This is a trend that needs to be reversed. Furthermore, developing countries should not imitate the wasteful consumption patterns of developed countries. Renewable resources will remain renewable only if the ecological principles underlying their sustainability is respected, and similarly non-renewable resources can be rendered renewable at least to a significant degree, by practising conservation and extensive recycling.

Food and Agriculture

Let us consider an important natural resources sector - food and agriculture - which is generally considered to be renewable. It is, however, renewable in terms of production only if properly managed. Acceleration of desertification, salinization, loss of productive soil, or loss of genetic resources, can significantly reduce the over-all level of production. To provide adequate food and nutrition for the world's population during the next two decades, food production would have to be doubled by the year 2000. There are some natural constraints, such as availability of good agricultural land and adequate supply of water which have to be considered in any planning process. Beyond these constraints, however, man dictates the pattern of development. If the strategies followed are ecologically sound and viable, it should be possible to increase agricultural production as required. Food is a net product of an ecosystem, and as long as the ecosystem remains healthy, it will continue producing food. However, improper management practices can undermine the agricultural system in various ways (Biswas 1984, Biswas and Biswas 1979). Since this is a vital sector, possible future environmental trends will be explored briefly.

Food is a fundamental basic need: it is imperative that its production be increased and its distribution improved, both to meet the anticipated population increase during the next decade and to improve the nutritional status of the malnourished people in developing countries, who according to World Bank estimates are likely to increease in numbers from 400-600 million in the mid-1970s to around 1300 million by the year 2000.

Since most of the good agricultural land available is already undercultivation (e.g., the Global 2000 (Barney 1980) study projects an increase of only 4 per cent in cultivated land during the next two decades), much of the increase in required food production will have to come from increased yield. While there is much scope to increase agricultural yields in most developing countries, the fact still remains that the number of people to be supported per hectare of arable land will continue to increase from the figure of about 2.6 observed during the early 1970s. Currently most strategies to increase yields place major emphasis on energy-intensive inputs and technologies such as fertilizers, pesticides herbicides and irrigation without concomitant emphasis on the long-term implications of continued use of such policies. In many cases, such strategies, which evolved during the era of cheap energy have already started to produce diminishing returns. Even though it is now universally accepted that the era of cheap energy is over, this fundamental fact is still not fully reflected in agricultural development policies. There is now considerable uncertainty about the overall impact of changing hydrocarbon prices on agricultural production during the next decade, and their eventual implications for the global environment, a fact that needs to be studied carefully. The uncertainty further extends to the ability of farmers to maintain and expand agricultural production while attempting to shift away from energy-intensive inputs.

Intensive land use, increased use of marginal land and continued dependence of agricultural production on climate will probably mean that the variability of food supply will increase markedly during the next decade. The real price of food will continue to increase, and it now appears that the agricultural and trade policies of a small number of exporting and importing nations will play an increasingly dominant part in determining the quantities of food available for trade and aid, as well as their prices on the world market.

Such development trends will have important implications for developing countries. Their overall requirement for imported food is likely to grow although at the same time the share of the world grain market of food-exporting developing countries is likely to grow from the level of little more than 10% recorded in 1975.

In principle, the environmental implications of future agricultural development are manageable, provided appropriate strategies are adopted. The future environmental trends will affect land, water, inputs and ecosystems, all of which, in turn, will have impacts on agricultural development.

Desertification

While during the next decade new lands will be brought under cultivation, some of the existing land will undoubtedly undergo soil deterioration due to four principal problems: loss of top soil, loss of organic matter, deterioration of soil structure and build up of toxic chemicals and salts. All these developments would reduce agricultural yields.

Many signs of stress that can be observed at present also affect soil availability, as well as its quality. The magnitude of the problem of desertification and the urgency of counter-measures to reverse the existing trends can be realized from the following estimates:

- The process of desertification is accelerating at great speed, and as a result some six million hectares of productive land are being lost, and many more are deteriorating to close to zero productivity, every year;
- On the southern fringes of the Sahara, some 65 million hectares of once productive land have become desert during the last 50 years;
- Some 600-700 million people, nearly 14% of the world's population, live in threatened drylands, and of these about 60 million are immediately affected by desertifications.

In addition to desertification, current trends indicate continued loss of good agricultural land to urban and industrial development. Increases in urbanization and suburbanization have accelerated the permanent loss of rich and alluvial soils, and in the industrialized OECD countries, urban land area is growing about twice as fast as population. An important future environmental trend could be the expansion of villages onto fertile land. There are already signs of this occurring in many developing countries, and the trend is likely to accelerate during the next decade.

Deforestation

Expansion of agriculture is a primary cause of deforestation at present, followed by demand for fuelwood and forest products. If present trends continue, it is estimated that both forest cover and stocks of commercial-size wood will decline by 40% during the next two decades in developing countries. From the environmental viewpoint, the potential impacts of this loss would be reduction of biological diversity and changes in climate and in soil and water regimes.

Biotic diversity is not only an important indicator of the ecological health of the planet, but also an essential storehouse for genetic materials for developing new crop varieties and medicinal drugs. While extinction has been the normal fate of virtually all species, the magnitude of deforestation projected in coming decades could mean that the rate of natural extinction would be trivial when compared to man-made extinctions, which will occur primarily due to loss of habitats.

So far as climate is concerned, the main potential impact of deforestation could be increased levels of carbon dioxide. While much of the carbon dioxide in the atmosphere comes from the combustion of fossil fuels, recent studies indicate that carbon stored in biomass is decreasing rather than increasing. Net decrease of biomass volume would imply carbon dioxide build-up in the future though present estimates of the amount vary considerably.

Water Resources

It is not only important to use land more rationally but also, it is imperative that water resources be used more efficiently during the next decade. At present, on a global basis, nearly 80% of all water used is for agricultural purposes. The need for irrigation is clearly indicated by the fact that even though only about 15% of the world's cropland is irrigated, it yields from 30 to 40% of all agricultural production. It is estimated that by the end of the present decade, in 1990, the total area irrigated in the world will increase to 273 million hectares, with 119 million hectares of this total in developing countries. More and more water will be necessary for irrigation. Thus, for developing market economy countries only, it is estimated that 22.2 million hectares of new land will be brought under irrigation, requiring 438 billion cu.m of additional water. Certain parts of the world have already started to face water shortages, and the situation is likely to become worse in the future if current trends continue.

This assumes, of course, that the existing pattern of efficiency of water use will continue. At present, on a global basis, 1.3 million million cu.m of water is used for irrigating crops, but for this 3 million cu.m of water has to be withdrawn (A.K. Biswas 1978). This means that 57% of the water withdrawn is lost. The 43% of this water reaching the field is not all efficiently used. Over-irrigation is endemic, which not only constitutes wasteful use of a valuable resource, but also contributes to development of adverse environmental problems such as salinity, waterlogging and rise of groundwater tables. These side effects reduce the yield of the very land which irrigation, at substantial investment costs, was supposed to make more productive.

As water requirements for agricultural, industrial, hydroelectric power generation and other purposes increase, there will be increasing demands for futher water resources development projects. Competing demands for limited water supplies or discharge of effluents to water-courses which would reduce water quality, and hence their potential use, could give rise to international conflicts, especially in the 148 of the world's important river basins that are shared by two or more countries. Similar tensions could arise in relation to coastal fisheries and offshore drilling. Accordingly, it is essential to codify guidelines for management of natural resources shared by two or more States.

The present decade has been proclaimed by the United Nations as the International Drinking Water Supply and Sanitation Decade. While both the United Nations Conference on Human Settlements and the United Nations Water Conference endorsed the target of clear water for all the world's population by 1990, on the basis of the present trends and of a realistic assessment of the future, this target is unlikely to be achieved, even though the number of people, both urban and rural, having access to potable water and sanitary facilities will undoubtedly increase tremendously.

Fertilizer Use

Where the various inputs such as fertilizers and pesticides, used to increase agricultural yield are concerned, the future environmental impacts will stem primarily from their more intensive use. The use of fertilizers per unit area is expected to increase in all regions during the next 10 years. The consequences of this increased fertilizer use are expected to be more serious for aquatic than for terrestrial systems. The adverse impacts may occur from the leaching of fertilizers to lakes, rivers and coastal systems, which could contribute to eutrophication. Much of the nitrogen currently entering surface waters - in the United States of America more than 70%, according to an estimate, is from non-point agricultural sources. Furthermore, the presence of nitrates in drinking water supplies is dangerous to children under the age of three. Fortunately, however, levels of nitrogen that may pose hazards to human health, about 10 mg nitrate/l water, are relatively rare, even in countries having high rates of fertilizer utilization.

Improper use of fertilizers could aggravate the problem of soil fertility. The atmospheric effects of fertilizer use are still not well understood but it has been reported that nitrous oxides from fertilizer application could deplete the ozone layer in the stratosphere. If this turns out to be a serious issue, future developments could present difficult choices between increased agricultural production and depletion of the ozone layer.

Pest Management

Despite the growing interest in integrated pest management which could reduce use of pesticides, their application will also probably increase over the coming decade. From an environmental viewpoint, the problems to be expected are somewhat similar to those witnessed in many parts of the world, during the 1970s even though their magnitude and intensity could be different. These are:

- Increasing biological concentration of persistent pesticides as they move up the food chain;
- Development of pest resistance to pesticides;
- Destruction of the natural enemies of the pest, which further reduces the total cost;
- Emergence of new pests which may not have been serious earlier;
- Impacts on human health due to contacts with persistent pesticides.

Energy

As noted earlier, present agricultural practices are heavily dependent on energy inputs. Energy is an important natural resource, whose availability is a pre-requisite for any development. The supply of energy, both commercial and non-commercial, is likely to remain an issue during the next decade.

Much emphasis is currently being placed on the possible future environmental impacts due to increased emissions of carbon dioxide resulting from the comnbustion of fossil fuels. It is anticipated that carbon dioxide emissions in 1990 will be about double those of the mid-1970s. While scientists generally agree that emissions of this magnitude will not have major impacts, there is growing concern that, if such trends continue, accumulation of carbon dioxide in the atmosphere may cause climatic changes in the early part of the twenty-first century. According to some projections, continued deforestation and energy-related emissions of carbon dioxide could increase the concentration of CO to approx. 600 ppm by about the year 2030. While the scientific community increasingly accepts the likelihood of possible global warning from such an eventuality, there is no possible way of confirming its validity, timing or specific impacts. Much work remains to be done on this question in the future.

Increasing use of coal during the next decade could contribute to serious environmental problems, most of which could be limited if proper control measures are undertaken. Without such control measures, mining could create large-scale land degradation, including destruction of natural habitats, land subsidence and water pollution through acid mine drainage. Without adequate control systems, coal combustion could contribute to emission of atmospheric pollutants like sulphur dioxide, nitrogen oxides, particulates and trace metals. Such emissions could increase ecological and health hazards, including the problem of acid rain (Holdgate et al. 1982).

Increased use of nuclear power would raise different types of environmental problems such as reactor safety, nuclear waste disposal and international security.

The major source of non-commercial energy is firewood, and it is not an inconsequential one: the total energy derived fromn wood in 1974 was about the same as from hydropower. Nearly 90% of global firewood consumption is in developing countries where the use of firewood is at present related to the level of economic development. The least developed countries and areas within countries tend to use the most firewood. According to FAO estimate, firewood requirements are likely to increase at the rate of 2.2% per year resulting by 1994 in a fuel wood shortage of 650 million cubic metres annually in wood-poor countries.

Increased requirements for fuel-wood are an important cause of deforestation, with its attendant environmental problems such as destabilization of nutrient cycles, soil erosion, decline in soil fertility, and diminished capacity of soil to retain water (and hence often increaed flooding). Accordingly, the organization and proper use of systematic fuel-wood plantation programmes in the future would, while meeting an essential need of the rural and urban communities, make a positive contribution towards environmental improvement (El Hinnawi and Biswas 1981).

What is essential is to organize and manage the supply of the so-called non-commercial fuels with a view to sustaining, and if posible augmenting, their supply as well as improving the efficiency of their use. With respect to the latter, the role of women is the most crucial one, since they are principally responsible for gathering firewood and water and are in charge of household cooking. Increased efficiency will be greatly facilitated by providing training to women in the use of improved devices for cooking and heating.

The possibilities of switching to new sources of energy during the present decade appear to be limited (El Hinnawi et al. 1983) and to a great extent the energy crisis for most countries, is a problem of oil. Kerosene is widely used in rural areas for lighting purposes, and diesel is essential for transportation and irrigation. While certain oil-intensive activities like further mechanization in agriculture and use of automobiles do provide some scope for conservation in developing countries the potential is somewhat limited, certainly significantly less than in the developed countries.

Marine Environment

While there appears to be little threat to the open ocean waters at present, coastal waters and enclosed or semi-enclosed seas are receiving increasing loads of pollutants, primarily as a result of man's activities on land which inject matter into rivers, coastal outflows and atmospheric fallout on the oceans. The coastal areas are of critical importance for the well-being of marine biota, on whom future food supplies may increasingly depend, and for human health, for it is here that man is directly exposed to contaminants from bathing and from seafood. Continuing assessment of the significance of present trends is essential for the proper management of these areas. Alternative courses of action must be identified so that they will be available when it becomes advisable to reduce the injection of critical pollutants into the seas from key sources. A more rational approach to the development of coastal zones would pay heed to the need to protect areas identified as critical for breeding and development of marine biota, yet these same coastal areas can be expected to become more crowded as a result of projected demographic growth, together with competing demand for agriculture, industry, transportation, tourism and other development sectors.

NEW PATTERNS OF DEVELOPMENT AND LIFESTYLES

Throughout the history of mankind, lifestyles and development patterns have never been constant, but have continually evolveed and changed with time. Furthermore, lifestyles and development patterns at any specific time vary from one country to another, and often there are significant differences between different parts of the same country.

Present lifestyles in advanced industrialized countries can be characterized by several factors, among which are intensive use of resources, high capital investment, high rates of technological developments, low rates of population growth, comparatively low unemployment and low rates of inflation, and the availability of a trained pool of personnel to carry out various functional tasks. Majority of the developing countries, on the other hand, have higher rates of population growth, low consumption of resources, high unemployment and underemployment, scarcity of capital (except in oil-exporting countries), high illiteracy rates, and often an agriculture-based economy with strong income inequality and widespread poverty. Overall economic growth and attempts at modernization of various sectors, which were expected to provide better equality and to democratize developing societies, have on the contrary often helped to accentuate economic and socio-political polarization.

Rural Development

The majority of the poverty-stricken people in developing countries live in rural areas, and their incomes are mostly directly linked to the agricultural sector. So far, the concept of "trickle-down" development has failed to improved their lifestyles to any appreciable extent. It is this sector which needs modification, and the present patterns of growth need to be drastically changed during the 1980s. Such modifications however, can only take place if the rural poor, and especialy those who are landless or have very small holdings and who constitute the core of the rural poverty problem, are specifically considered to be the important beneficiaries of any development strategy. It is not going to be easy to reverse the past and existing trend, since the rural poor are often illiterate, unemployed or underemployed and in poor health, and thus often are external to the decision-making process which selects development strategies that affect their lives. Future development efforts will have to consider not only the total benefits accruing from a project, but also how the benefits are distributed. Any development, in which the distribution of benefits is markedly skewed, so that they accrue primarily to a select group of elites, is bound to be unsatisfactory and unsustainable on a long-term basis. Narrowing disparities in the distribution of incomes is likely to improve the environment.

There are many reasons why rural development has not been more successful fo far. They include:

(a) Higher rates of population growth, which mean that the meagre productive assets owned become more fragmented in successive generations;

(b) Lack of education and training, which means that not enough information is available as to how the meagre assets of the rural poor can be used more effectively and productively;.

(c) Poor health due to unavailability of adequate food and nutrition, lack of potable water, sanitary arrangements and health care facilities;

(d) Weak links to the organized market economy, i.e. lack of access to credit, essential inputs and improved but appropriate technology, problems with marketing of products, etc.;

(e) Use of resources and the environment, for sheer survival, in ways which are unsustainable over the longer term.

Poverty and Environmental Degradation

The presence of widespread poverty is often the cause of serious environmental deterioration in developing countries. When reinforced by accelerating population growth, it contributes to the continual erosion of the resource and environmental base from which people must earn their livelihood,thus completing a vicious circle which is proving difficult to break. To meet their desperate immediate basic needs for more survival, the rural poor have no other option but to cultivate marginal land which is prone to heavy soil erosion, graze their livestock on land that is becoming barren from overuse, cut shrubs and trees for fuelwood, thereby reducing the stability of soil and water regimes, and burn dung which otherwise could have improved soil fertility. Trapped in conditions of absolute poverty, their actions contribute to the further deterioration of the renewable resource base, making their plight even more desperate with the passage of time. Thus, many of the world's most severe environmental problems are in part a direct consequence of extreme poverty,and it is neither likely nor realistic to expact that impoverished people living at the margin of existence will consider the longterm sustainability of the planet at the cost of their own survival. Without determined attempts to improve their living conditions through further development, the situation is unlikely to get better. This is a major trend that needs to be reversed as soon as possible, before damage becomes too extensive and irreversible, so that the renewable resources base of this planet can be conserved, and wherever possible enhanced for the good of both present and future generations. As the recently issued report on Global 2000 (Barney 1980) by the United States Council on Environmental Quality has concluded: "Only a concerted attack on socio-economic roots of extreme poverty, one that provides people with the opportunity to earn a decent livelihood in a non-destructive manner will permit protection of the world's natural systems. Nor will development and economic reforms have lasting success unless they are suffused with concern for ecological stability and wise management of resources".

Appropriate Technology

Development depends not only on people but also on the resources and technology they have access to, and the environmental framework within which these are utilized. Developments, both in the industrial and the agricultural sectors, should not necessarily mimic western models and technology. They should be closely related to the resources base of individual countries, which needs to be assessed and then efficiently developed on a long-term basis for the good of the maximum number of people, and with due regard for the environment. During the next decade, it is essential that biophysical resources be mobilized effectively so that the goods produced, industrial and agricultural, are less extravagant in the use of resources,do not contribute to environmental deterioration, and improve the overall quality of life.

By itself, technology employed in the service of development is neutral, but how it is used can determine the success or failure of a project. Choice of technology depends on a variety of technical, social, economic, environmental and political factors, and many times what may be considered to be the most appropriate technology in one country could turn out to be the most inappropriate for solving almost identical problems in another. A review of the history of modern development will often indicate that straight transfer of technology from developed to developing countries has often created more problems than it has solved. While South-South technology transfer through technical co-operation between developing countries makes a great deal of sense, it should not be axiomatically assumed that such direct transfers will present no serious problems. Developing countries are not all the same; they are often at different stages of development and may have different social, economic and institutional backgrounds.

To the extent it is possible, approPariate technology for developing countries should be labour-intensive. While this point has received the attention of many planners and engineers for a long time, attempts to use labour-intensive techniques on a continuing basis can be best described as timid and half-hearted. The few successful examples of this approach have been due to the determined labour of a handful of dedicated individuals, and were mostly isolated efforts. Even in these few cases extensive documentation of the techniques used, their costs, effectiveness and public acceptance, and other relevant information are not readily available to others who may wish to use similar technology. Very little has been achieved at implementing such successful techniques at national levels. The virtues of appropriate technology, in short, are more often preached than practised.

Many instances could be cited of socially and environmentally inappropriate technology being imported to developing countries, through either bilateral or multilateral aid programmes, without critical appraisal. Foreign consultants and contractors are often used to plan, design and implement projects. In the majority of these cases, they are not fully familiar with the prevailing social, economic and cultural norms of the developing countries concerned, and accordingly they often use criteria which are based on the experience and knowledge gained in the advanced industrialized countries which may not be applicable locally.

Some attention has been paid during the past decade to elaborating the concept of environmentally sound and appropariate technology, studying the problems and methodology for producing such technology, and developing criteria and methodologies for selection of the best results. However, the application of these concepts in an operational context leaves much to be desired, and needs to be accelerated.

There has been some discussion in recent years of the question of nonwaste or low-waste technology, which can be defined as the practical application of knowledge, methods and means so as to provide the most rational use of natural resources and energy and to protect the environment. Expressed differently, it is the planning and management of human activities in order to provide the minimum waste of materials and energy both in production processes and in consumption patterns. Waste should be considered as a loss of potential resources, and attempts made to reduce waste will undoubtedly produce numerous beneficial results. The development and promotion of nonwaste technology which eventually should replace conventional technology, is a long-term endeavour of the greatest importance, whose realization would contribute to positive changes in all sectors of industry which would not only promote more rational use of natural resources, but also improved environmental quality.

It is clear that research and development work to promote non-waste technology has still not reached the desirable level. There is an urgent need for further work to devise criteria for economic evaluation of non-waste processes, especially of the transformation of wastes and for the identification and operation of non-waste production processes which would take full account of environmental factors.

Hazardous Wastes

The persistent pesticides mentioned earlier are but one of many classes of synthetic organic chemicals which are increasingly manufactured and released into the environment, where their presence has become ubiquitous. Recent UNEP reports indicate that some four million identifiable chemicals are in current use with new chemicals entering the market annually, many of which may have unintended adverse effects on man's health or well-being. Some of these effects may be delayed by transfer processes such as biological concentration as they move up food chains. Similarly, disposal of chenmical wastes is in many areas proceeding without regard to future risks, for example, to ground water, which, by the time they are detected, may be prohibitively expensive or technologically impossible to correct. Man's exposure to environmental pollutants, whether in food, water or the air he breathes, is a stress which may impede his functioning or even lead to mortality, especially in cases where malnutrition or other deprivations have already applied other forms of stress. Similarly, much of the biota on which man depends for his well-being, such as agricultural crops, may be put under stress by the impact of chemical (and other) pollutants. In view of the trends of increased production of synthetic chemicals and more intensive use in industry, agriculture and other development sectors, increasing attention must be paid to assessing the significance of trends in pollutant releases, pathways, loads and effects to ensure that warnings, where necessary, may be sounded in good time, and that alternative courses of action to society to reduce the threats are available.

Lifestyle and Energy

The lifestyles and development and technological patterns that have generally evolved during the past three decades have been primarily energy-intensive and are highly dependent on oil. Sharply increased oil prices and unreliability of supplies are now forcing major adjustments for both developed and developing countries. While such major changes have had significant impacts on industrialized nations, the impacts on oil-importing developing countries have been very serious indeed, limiting their access to energy and burdening them with economic costs which they find hard to bear, and sometimes devitalizing all other sectors. A major problem facing the developing countries is one of reconciling the need for increasing the energy input for productive economic activity within the context of a global situation of depleting energy supplies and rising costs. In addition there is the further problem of a highly skewed energy consumption pattern among people of different income levels, with people in the upper income brackets using disproportionate share of energy.

It is essential that possible alternative responses to this situation be urgently reviewed. Solutions could include, inter alia, an intensive drive to conserve energy in all spheres, changes in lifestyles that would use less energy, especially oil, then before, and development of alternative energy sources that are both renewable and indigenous. Further consideration should be given to coal, natural gas and other forms of energy, with careful assessment and review of environmental and other potential adverse affects associated with such systems, including the problem of deforestation due to increasing use of firewood and the transformation of good food-producing land to growing biomass for conversion to fuel. These alternatives, however, may not be the final solution for many developing countries, which after paying higher energy costs, may find themselves with insufficient resources to sustain a satisfactory rate of growth. Intensive international cooperation will be necessary to overcome this hurdle.

People's Participation

New patterns of development will require a more decentralized and participatory approach to planning. Past experiences indicate that centralized, top-down efforts fail more often than they succeed. The leaders and bureaucrats may be more educated and sophisticated than the rural populace but the "best and brightest syndrome" often fails in development.

Accordingly, people's participation in shaping events that will utlimately affect their lives is an eonomic necessity as well as social must. The people know what is required, and are familiar with local conditions, availability of indigenous resources and the strengths and weaknesses of the community. The people must be responsible for the creation, operation and maintenance of development projects. Such planning and implementation processes will ensure that their needs are properly identified and that the solutions will be viable. In addition it will make them realise that the project is theirs, and that they therefore have a responsibility to optimize the use of resources and then to maintain the development works.

Development can be sustainable if it is based on the solid foundation of equity, mobilization of indigenous resources, use of appropriate technology and full utilization of human capital. Development strategies have to be centred around people, and human resource development should be planned so as to provide the necessary conditions for the much needed change in attitudes and prepare for a more conducive atmosphere wherein new ideas and technologies can be successfully absorbed.

While some conceptual studies have been carried out in the past on the incorporation of public participation in the planning and decision-making processes, and a few individual studies are available on their implementation at the project level, much work remains to be done on how to make such practices operational, especially at higher than project levels.

Environment and Development

Much work has been done during the past decade on the question of compatability between the environment and the socioeconomic objectives of development, and on the need for and feasibility of integrating them systematically with each other. Starting from the Founex meeting before the Stockholm Conference on the Human Environment, and through the work of UNEP and other organizations, it has been established that environment and development are complementary, and represent two sides of the same coin. Throughout the decade, perceptions of the development process have been changing and greater awareness has been developing on the importance of environmental considerations in protecting and maintaining the resources base on which development depends.

Conceptually, the complementarity between environment and development was clarified during the last decade, and to a large extent was accepted by planners and decision-makers. However, there has not been much progress in translating these concepts into practical and operational terms. Whatever progress that has been made thus far has been primarily at the project level, which not surprisingly is the simplest. Integration of environmental considerations in development plans has not been a success so far. Undoubtedly this should be a priority issue for the coming decade.

A critical analysis indicates that there are at present many opportunities for promoting development processess that will sustain long-term productivity. For example, integrated water resources development can be better planned and managed to ensure better and more reliable water availability,mitigate flood damage and increase aquaculture, and at the same time reduce adverse environmental impacts on land, such as salinity or waterlogging, and prevent the spread of water-borne diseases. Agricultural systems could take advantage of integrated pest management, organic fertilizers and nitrogen-fixation, and reduce the use of persistent and destructive chemicals. Transportation systems can be planned to discourage urban sprawl and reduce dependence on petroleum. Land-use patterns can be controlled so that good land remains available for agricultural purposes and is not lost to urban and industrial developments. There are many other ways in which both developed and developing countries can promote environmentally sound development. However, while more than enough information is currently available which can be successfully used to promote such development, it is unfortunately still not being widely used. Measures to promote environmentally sound development should therefore be a top priority for the coming decade.

While any development activity will have some impacts on the environment, the overriding consideration in the selection and implementation of development strategies has to be minimization of environmental costs and maximization of benefits. It is therefore essential that future strategies and projects be subjected to systematic environmental impact assessments. An important activity of the next decade has to be the development of new methodologies for environmental impact assessments that are reasonably accurate, and can be carried out within a limited budget and time-frame. The techniques should not be too complex, so that people can be trained to use them comparatively easily. Multidisciplinary and intersectoral studies and research need to be promoted in order to develop and continually refine such assessment techniques.

While there is increasing realization of the need to accept certain fundamental realities, the concept of the essentiality of long-term ecological sustainability of any lifestyle is yet to be widely accepted. The search for appropriate lifestyles will require changes in both supply and demand of goods and services, including the choice of goods to be produced and techniques used to produce them. Furthermore, production should be responsive to the needs of the vast majority of the people, and not only of the privileged few. Lifestyles must be in harmony with nature and in equilibrium with the prevailing circumstances. In other words, wasteful consumption should be discouraged, natural resources used rationally, and the environment should be protected.

There is an urgent need for demand orientation, especially reordering of consumption patterns in profligate societies, which will permit the transition from a consumer society proccupied with vast resource consumption to a conserver society engaged in mere constructive endeavours. What is needed during the next decade is more equitable development styles which would encourage the poor to productivity by granting them access to resources which they presently lack.

Exhortations about the need to alter lifestyles are unlikely to have much success in either developed or developing countries. The desirability of changing lifestyles in developed countries has been recognised by many of their citizens in recent years, and some examples of new attitudes and perceptions can be discerned; these are still very few and their overall impacts, though not negligible, have been somewhat limited. What is necessary is to find viable means which could help achieve desirable changes.

OTHER CONSIDERATIONS

In addition to the discussions under the previous three broad categories, there are a number of general comments worth making that relate to major environmental trends in the next decade. Some of these are implicit in the previous sections.

First, it should be emphasized that the various regions of the world are each quite heterogeneous in terms of types of ecosystems encompassed, extent and magnitude of different problems confronting them, and institutional infrastructures available through which solutions could be implemented. This means that programmes need to be developed in response to the specific requirements of the regions, even though it may be possible to include them within broad global solutions.

Second, while existing knowledge can be applied to ensure proper environmental management, this will prove futile if such exercises are not backed by strong environmental assessment programmes that will carefully assess the magnitude of each problem, monitor the results of its management, disseminate information on such results and identify gaps in knowledge that needs to be filled.

Third, neither environmental assessment nor environmental management will progress in substantial measure without strong emphasis on the supporting measures identified at Stockholm, environmental education and training, public and technical information and technical assistance, especially in the developing countries in the next decade.

Fourth, many of the major problems that mankind will be facing during the next decade are not new. We already know of their existence and in many cases enough information is available to solve them. Thus, what is necessary is determination and political will to implement the solutions.

Finally, recommendations, resolutions and agreements on plan of action, while an important first step, are not enough. Much time and resources were spent in preparing the action plans that resulted from various past conferences of the United Nations. While funds were available to develop the action plans, not enough resources are available to implement them at both national and international levels. Without determined attempts to generate such resources in order to transform the plans into actions, the efforts made will be wasted and action plans will become academic exercises that would gather dust on bookshelves. This is a trend that needs to be reversed during the next decade.

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SOME PROBLEMS OF ENVIRONMENTAL EDUCATION

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FIRST STAGE OF ENVIRONMENTAL DISRUPTION

It is rather difficult to give proper definitiion to the word "environment" itself, because the concept of environment is changing along with the development of society, technology and politics.

In 1970s, mankind, for the first time, became aware of the menace of the serious environmental disruption caused by too rapid growth of industrial activities in industrialized countries. The innovation of technology and remarkable growth of mass production system are also thought as main causes of the problem.

This industrial development was hitherto believed unquestionably as real progress of civilisation. Now, it began to play very important role on disruption of the environment, and gave threat to human health. Through air, water and other pollutions, children, old people and weak are severely suffered. Ecosystem in nature is also severely damaged.

Citizens stood up to convict enterprises or factories which were thought responsible for the emission of polluting substances. The environmental disruption became world wide concern.

Scientists and technicians played very important role at the stage. Their activity resulted in the fruitful UN Conference on the Human Environment, held in Stockholm in 1972.

However, in the Conference many developing countries expressed their real feeling that they did not have much concern to the pollution but to develop their own industries. They expressed their thought in the words "we want pollution".

THE SECOND STAGE

In the Stockholm Conference, many recommendations were mode on Environmental Education (E.E.) including the wide scope of education programmes to educate rather high level persons, those are, men of industrial circles and dicision makers.

But after 10 years since the Stockholm Conference, mankind was compelled to face with a new dimension of problems. They should confront with the environmental disruption originated not only from the acivities of heavy industries, but also from daily life activities of common people.

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The huge enterprises took necessary measures to reduce their effluents, and succeeded to some extent in reducing pollution though not yet complete. While on the other hanbd, the threat of environmental disruption through daily life's wastes became more and more serious, e.g., by the use of synthetic detergents and other chemicals together with the use of cars. It is needless to say, the real responsibility comes back to makers of those substances, but users cannot be without guilt.

Thus, the importance of E.E. has become widely recognized newly, especially among common people.

Even in this stage, it is important not to forget to pay keen attention to the activities of big enterprises, national and especially of multinationals, in developing countries, which have taken insufficient measures to reduce hazards. The accident in Mexico a few months ago, and recent tragedy in Bhopal show the examples.

But at the same time it became necessary to pay more effort to educate people to behave to avoid more contamination caused by their own activities.

THE THIRD STAGE

One more problem to be considered is the relation between man and environment, especially nature. In recent years, the destruction of nature is becoming more and more serious. Deforestation in developing countries is caused both by daily life activities of natives and by big enterprises. The destructions are causing serious damage to the lives of natives in return. Moreover, this has other environmental influences on a global scale.

The reclamation of Amazonian tropical forest is now under world wide concern. The deforestation of tropical forest in South East Asia by Japanese enterprises has now become one of the most serious problems of the world. Both destructions are not only causing direct damage at a local level but also have world wide bad influences on the environment indirectly.

The disputes between citizens and some factories were limited rather in narrow spots. Nature disruption or contamination of environment in daily life are difficult to confine in narrow area. And in those cases it is difficult to take direct measures to solve problems.

It is obvious, in such cases, E.E. plays essential role, and the E.E. methodology requires important principles. Many people pointed out the importance to promote new "ethics" to match the requirement.

This new ethics should be the guideline not,only for the big enterprises or decision makers but also has to be fixed in the minds of citizens.

The problem is, there is not yet common understanding of this new ethics even among ourselves. And I believe it most important and urgent to establish our common recognition on this new ethics between man and environment, and I hope this theme would be discussed on every occasion.

SUMMARY AND CONCLUSIONS

I wish to summarize my view as three main points.

First: It is necessary even now to strengthen research works, survey and training to tackle with the solution of environmental hazards caused by industries. We must keep keen watch continuously. We have many experiences in Japan, performed by scientists and teachers. They educated citizens about exact scientific knowledge of hazards originating from factories, and with confidence, people stood up to act.

Second: Many teachers in Japan have played most important roles in educating students in formal and informal education. Examples may be published in coming Conference planned by us at the end of August this year in Tokyo and other districts in Japan.

Third: International collaboration is most essential especially for the Japanese who are rather indifferent about the world wide issues of environment, because Japan is isolated from continent and less suffered from pollution from abroad. The environmental disruption caused by the Japanese enterprises in the tropical forests do not reach the conscience of common people. I hope the Japanese would learn more about the facts and feel responsibility about the global issues of environment.

Finally, we should not forget to continue our action to the government, especailly to pay more attention to E.E. I think this is the same situation in each country and to achieve our purpose, it is inevitable to work in international collaboration.

ENVIRONMENTAL EDUCATION AND MANAGEMENT

S. V. Chittibabu*

INTRODUCTION

"Education is all round development of man" so said Father of the Nation Mahatma Gandhi Education unfolds as it were one s latent talents and capabilities It is a process of continual adjustment of one to oneself to society and to his environment. Adjustment is an active process with a positive approach Education makes one sensitive to one's surroundings enables one to cherish values in life and inculcates in one a catholicity of outlook Environmental factors shape the individual s development Education thus means much more than giving mere instruction It brings out the capabilities and potentialities of the child and channelises them toward a higher and nobler life It sets afoot development from within. It helps the flowering of the genius in him It is character building It promotes self reliance and self confidence As Swami Vivekananda would put it education is the manifestation of the divinity within.

EDUCATION AND ENVIRONMENT

It can hardly be gainsaid that environment influences one s education. The interaction between education and environment can be described as follows

a) Education creates the urge for a clean environment.
b) It inculcates in the young minds the basic principles of sanitation and hygiene.
c) It helps pupils and students appreciate the need for conservation of our multifaceted heritage
d) It teaches newer and environmentally safe technologies.

Our Rich Heritage and the Habitat Diversity

Plants and animals act as indicators of a healthy environment Nature is an open book Plants help in maintaining the oxygen balance of the atmosphere India has a rich spectrum of flora and fauna She is considered as one of the seven centres of origin of cultivated plants We have different types of vegetation namely tropical subtropical temperatre alpine and desert vegetation. India has about 15 000 species of vascular plants alone among the world s total of a quarter million species

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India has a great many species of invertebrates including beautiful insects like butterflies She ranks seventh among the major marine fishing nations of the world. It accounts for about 45% of the fish landings from the India Ocean. There are about 2000 fish species and India s share is about 1400 fish species and many species of amphibia. reptiles birds and mammals But about 150 animal species are today threatened with extinction.

The monitoring of their growth and census will be helpful to evaluate the impact of developmental activities upon the environment The diversity of flora and fauna should be preserved and protected to maintain the equilibrium in the ecosystem It is said that the disappearance of one plant species can result in the loss of 10 to 30 dependent species including other plants insects higher animals etc.

Botanical gardens and zoological parks and bird sanctuaries play a very important role in education research and conservation. The community s awareness of its heritage of not only plants but also of animals is essential for conservation.

Jawaharlal Nehru aptly observed once thus: "In spite of our culture and civilisation in many ways man continues to be not only wild but more dangerous than any of the so called wild animals."

Pitambar Pant the first Chairman of India's National Committee for Environmental Planning and Coordination had said "Conservation is in effect a form of development Development and conservation are not mutually exclusive "

It is significant to note that the ancient Sangam literature of Tamil speaks of the close harmony of people with the environment Even the classification of poetry was based on goegraphy of the environment The geographical environment recognised to form a basckdrop for many blank verses and lyrics is described as follows:

1 Kurinji: Pertaining to the hills and mountains
2 Mullai Pertaining to the jungle and forests
3 Marutham Pertaining to the plains
4 Naidal Pertaining to the sea and sea coast and
5 Palai: Pertaining to the arid and desert region.

The documented history of the conservation movement in India goes back to pre-Christian times Emperor Ashoka (about 242 B.C.) in his Rock Edicts had decreed that certain biota were not to be killed or destroyed.

The Need for Environmental Management

The work of an Environmental Protection Agency in a country like the USA which assesses. manages and reduces the environmental response to cleaner discharges by the industries in developed countries is very encouraging. One of the lessons learnt has been that the industries which curb and control pollution discharges through recycling and application of law and non-waste technologies have been often able to achieve greater profitability than competitors who remain with older and more polluting technology. Japan has set the trend in this direction.

The inducement to promote environmentally-safe technologies in Japan. could be traced to the lessons she learnt in the 1960s. The manifestation of diseases due to environmental pollution such as the Minamata disease caused by organo-mercuric compounds dissolved in the industrial effluents discharged into the sea passed through fish to man and the Yokkaichi asthma (cadmium-poisoning through consumption of contaminated rice as it happened at Yokkaichi) has given rise to considerable concern (UNEP 1984).

The disastrous effects of acid rain in many countries such as Sweden and West Germany occur due to exhaust fumes of discharged sulphur dioxide and toxic aerosols mixing with the moisture-laden clouds in the atmosphere When the clouds cool sulphuric acid comes down with rainwater These acids harm lungs they mobilise toxic metals harm vegetation and fish and other organisms So events occurring in the plant and animal world serve as warnings for man tinkering with his environment

Role of Effective Public Opinion

The effective public opinion in the developed countries stemming from the educated and enlightened public demands strict action from the Government to restrict the pollution of water, air and soil and Governments have to respond. The Japanese automotive industry has the world's most stringent regulation exhaust emissions of gases are to be reduced as follows: carbon monoxide 5% hydrocarbons 4% and nitrogen oxide 8% of the pre-implementation levels. The lesson one learns from Japan's example in economic development and environmental protection could be useful to usher in environmentally safe technologies.

The applicaton of 200 clear and safe technologies in eco-industries in France has led to savings not only in energy but also in procurement of raw materials. In Denmark this application has led to financial benefits in 44% of cases.

With the application of environmentally safe technologies, tragedies like the Bhopal gas leak disaster through emission of methyl isocyanate (MIC) could be averted. The practice of location of factories and chemical pollutants in and near crowded localities needs rethinking and ecological clearance must be made mandatory before sanction.

The Global Convention on Conservation

The World Conservation Strategy of 1980 presented a convincing case for conservation. It marshalled evidence to prove that conservation is absolutely essential for sustained development over long periods and that it is not a hinderance to development, but a vital ingredient of progress. The Convention on Trade in Endangered Species (CITES) stoped to a great extent the ruthless exploitation of living resources.

The World Industry Conference on Environmental Management (WICEM) held in Versailles in November 1984, diagnosed the many ills facing industry due to its neglect of environmental protection and brought to focus the many issues that lend support to environmental protection.

Hazards of Desertification

Two of the greatest dangers facing mankind are the spread of desert and deforestation. There is link between the two: "Deforestation today is drought tomorrow and famine the day after", said Laurent Fabius, Prime Minister of France. Tropical deforestation is a very serious issue. The loss is alarming. While the area of forest cover is stabilised in the developing world, forest resources of the developing countries are being lost at the rate of 11 million hectares a year. According to the World Bank's Forestry Adviser John Spears "the forestry resources of 9 out of 83 developing countries will completely disappear by 2000 AD and further 13 countries will lose theirs by 2040 AD."

Deforestation leads to staggering loss of topsoil and accelerates soil erosion. In India, the quantity of topsoil loss is put at 6000 t/yr about a decade ago. This should be much more now. Only about 14% of our land area, much below the desired desideratum of one-third of total land area, is forest covered.

Productivity of Forests and Land

The productivity per hectare of forest area in certain countries is given below:

Country	Productivity equiv Rs/ha
West Germany	565
Austria	336
Switzerland	494
India	28

The reasons for our country's poor productivity of forest area are over exploitation, mismanagement and conversion of valuable forests into wasteland (Krishnamurthy 1984a). These apart, the alarming rate of depletion as revealed by recent National Remote Sensing Agency data of 1980-82, speaks of a loss of about

103 404 sq.km of forests since 1972-75 (Paryavaran 1984).

The loss due to water encroachment in Kerala is put at 100 million ha and that due to wind erosion in Kachch (Kutch) at 50 million ha The area affected by annual floods is 40 million ha. (1980 data). Water-logging and increasing soil salinity affect 13 million ha. Thus some 61% of our agricultural lands and 72% of non-agricultural lands get continually degraded. About 6.5 mill. ha of land are located in coastal States of India. This includes 6 million ha which remained very productive till the other day

Wealth of the Mangrove Forest

The total area under mangrove forests (tidal forests) is about 6678 sq km in India (Krishnamurthy 1984) This roughly accounts for about 7% of the world's most luxuriant mangrove formations found in the Indo-Pacific Region.

The mangrove forests of Pichavaram alone taking it is an example of the Indo-Pacific mangrove contribute 1 566 tonnes of carbon per year as organic material for the nourishment of adjacent Bay of Bengal seaboard's organisms and 261 tonnes of carbon as organic materials for neighbouring estuarine organisrms. Only 783 tonnes of carbon per year were utilised and retained for use within this ecosystem (Subramanian et al. 1984). This would show the tremendous export potential of the mangroves to the adjoining coastal sea for the use of the marine denizens. This is reflected in enhanced fishery yield. With the denudation of the mangrove forest canopy the sea erosion along coastal stretch occurs. Mangroves also serve as a buffer to arrest the fury of the cyclones particularly on the eastern coast of India. But for their protective shield, the impact of cyclone along coastal stretches would be greater. The accelerated denudation of mangroves in India has resulted in substantial reduction to about 50-60% of the area that existed at the end of the last century (Krishnamurthy 1984) Not less than 10 species of mangrove vegetation are threatened with extinction in India alone (Krishnamurthy 1984).

Concept of Biosphere Reserves

It is significant to note that realising the importance of living resources and their fast rate of depletion, the Government of India have designated so far 13 Biosphere Reserves for protecting preserving and conserving the variegated living resources of our country. They include representatives from the heterogenous habitats such as the mountains (The Nilgiris, Namdapaha-Arunachal Pradesh). the sea (Gulf of Mannar, Rann of Kachch), the desert (Thar). etc.

Thus environmental education should start from the school level to pass on to posterity our rich heritage. As Theodore Roosevelt said, "The nation behaves well if it treats the natural resources as assets which it must turnover to the next generation increased and not impaired in value."

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PROTECTING THE ENVIRONMENT: THE ROLE OF EDUCATIONAL INSTITUTIONS IN INDIA

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INTRODUCTION

We begin by asserting that there is a new world coming, a world where man lives in harmony with his environment, and that is being built in the classrooms of schools and universities. This optimism is based on the wave of environmentalism which ushered in the seventies in the West, and which is now making a ripple in India due to the wave of environmental optimism initiated and pushed by Mrs Indira Gandhi, and continued by her successor. The optimism that something could be done to control the degradation of the environment without necessarily sacrificing developmental programmes essential to alleviate poverty, has now ignited the interest of professionals, administrators, and some citizens. Conscious efforts are being made by government departments such as Central and State Departments of Environment to encourage both research and regulation of environmental issues. Various organisations, voluntary and non-governmental, have been set up to increase the environmental awareness in the society. However what is urgently needed is the building of a constituency for the future, a constituency of future citizens which will expect nothing less from its government and the private sector than a quality of life, and a livable environment where the man will live in dignity. Building of such a constituency is the task of our educational institutions. The nation where the man will live in dignity. Building of such a constituency is the task of our educational institutions. The nation cannot afford to keep on producing scientists, lawyers, administrators and businessmen who would view, as many of them do now, in the next ten to twenty years pollution as a minor white collar crime, an irritant necessary toward economic development, and a value which can be subordinated to other immediate concerns of the society. 'Environmental Education' would have to aim at producing a citizenry, creating a constituency of environmentally oriented people, that is knowledgeable regarding the biophysical and man-made environment and its problems, aware of how to solve these problems, and motivated enough to work towards their solution. Such a challenge has

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to be taken by educational institutions, and among these, universities and colleges will have to show the leadership. This report is on the role and contribution of universities in protecting the environment with emphasis on universities in the State of Uttar Pradesh.

PHILOSOPHY AND OBJECTIVES OF ENVIRONMENTAL EDUCATION

It is vital to effectively educate man regarding his relationship to the total enviroinment, the relationship which is based on the mutuality of respect rather than on superior-subordinate relationship. Hence major goals of environmental education should be to help individuals acquire:

1. A clear understanding that man is an inseparable part of the biosphere which consists of man and his built-in environment, the existing biophysical environment, and the sustenance of the ecological balance.
2. A broad understanding of the biophysical environment and its importance to human race.
3. A fundamental understanding of the nature of environmental problems confronting man, how these problems may be solved, the basic responsibility of the society and government to work for solving such problems.
4. Development of environmental ethics which will motivate people to participate in the decision-making process and to demand for a protection of the environment so as to advance human welfare and dignity.

These goals are derived from the philosophy of environmental education which asserts that man is an integral part of the ecosystem from which he cannot maintain a separate existence. Within this system, the man's culture, values, his organisations, scientific and technological knowledge, and social arrangements are elements through which man interacts with the biophysical environment. Man uses and exploits resources available in the biosphere towards his immediate gain. An understanding of the use and exploitation of such resources by man is essential. In addition, a strong understanding of the impact of man-made components on the functioning of the biophysical environment is necessary. Such an understanding can be sustained through an educational process which highlights the scientific and technological explanations of the factors which cause pollution; kinds of poillution (such as indiscriminate use of pesticides, toxic substances, air and water pollution, urban blight, congestion, and general degradation of environment); and laws including pollution contrtol policies and programes, natural resources management, techniques, and what remedies are available for them to fight for protecting the environment. It is through the educational process that man's attitude towards environment is to be shaped. Hence, the

environmental education should aim to:
a. provide factual information to students which will lead to the understanding of the intricate system of ecological balance, and man's place in it,
b. develop a concern and respect for the environment.
c. inform people as to how they can play an effective role in protecting the environment by demanding changes in laws and enforcement system.

MEETING THE OBJECTIVES

These objectives can be met by effecting appropriate changes in the educational system. It is suggested that the environmental education programme at various levels of education should provide emphasis in the following manner:

I. Primary Education Level:

Main emphasis ought to be on introducing to the student an awareness of his natural surroundings and the gifts of environment. The curriculum should include the definition of the term environment, various diseases and problems resulting from environmental degradation, prevention of diseases, and what a man should do to protect the environment.

II. Junior High School Level:

Introduce students to a conceptual background of environmental factors including the scientific and technological causes, abuses of the environment by individuals and industries, kinds of diseases resulting from pollution, and preventive actions. The emphasis should be on the causes of pollution and techniques of pollution control (including community action, pressure group, use of political parties, demanding adequate protection by laws and enforcement system).

III. High School/Higher Secondary School Level:

While upto Junior high school level, students would receive a compulsory environmental education, at the high school level, optional environmental education programme can be built in their respective stream of courses. For example, students specializing in science-related courses (such as chemistry and biology) could receive more specialised education of environmental problems as a part of their course coverage. Similarly students in arts and commerce programme can be further exposed to socio-economic factors, governmental system, management techniques, and social responsibility of industries to protect the environment. However, students should be exposed to other disciplines. High School and

Higher Secondary School students should see the issue of environment as a future responsible citizen, to protect the environment not only for their generation but also for the generations to come.

IV. Universities and the Environment Studies:

Beyond the high school level, universities have two specific roles to play in environmental education: (i) to provide leadership by conducting research on environmental problems and preparing scientists who would then continue research and (ii) to train experts for managing the environment. These specialists would require first the basic undergraduate (and where necessary the doctorate) education and training. At the same time, it should be recognised that environmental study and research cannot be entirely left in the hands of traditional disciplines. From the very beginning, the emphasis on environmental education has been multidisciplinary; consequently at the university level, not only a great depth of discipline but also a broad breadth of knowledge dealing with interrelatedness of environmental problems (beyond the horizons of natural sciences, engineering and medical sciences) which deal with socio-economic, cultural and legal aspects would be required.

It is not suggested that pure dislciplines, should not continue to provide the fundamental strength in environmental research. These disciplines have been the mainstay of forging new frontiers of knowlege, but at the same time they have erected disciplinary barriers.

STATUS OF ENVIRONMENTAL EDUCATION IN U.P.

The above listed comments and curricula suggestions were discussed with the officers of State Ministry of Education and with Heads of Universities and Institutions in Aligarh, Kanpur, Lucknow, Varanasi and Allahabad. Observations, divided into two parts, are listed below:

A. Education at the School level

The MInistry of Education of U.P. Government is not only aware of the need to impart environmental education to its students, but has taken substantive measures to introduce necessary curricula changes. For example, starting from Class 1 lessons on home sanitation, social forestry, health and personal hygiene, need for fresh and pure air, etc. are included. By the time, a student reaches the level of Class 7 and 8, he is told about the advantages of forests, impact of environmental degradation on society, destruction of forests and disappearance of orchards and grazing lands, pressure of growing population on the environment widespread use of fertilizers and insecticides, air and water pollution, etc. Charts and diagrams have been prepared to illustrate the impact of environmental degradation on the society. In addition, film slides have been prepared, a documentary film is planned, and a booklet has been published which deals with environment and the increasing population. It seems that students of U.P. State are receiving adequate environmental education upto Class VIII.

From Class IX to XII, the Board of Secondary Education determines curriculum and course contents. As students are required to take science and social science courses, they are instructed on the relationship of man to his environment (Botany and Zoology), pollution and quality of environment (Geography). However, there does not exist a subject on environmental studies at the High School level. It is recommended that the U.P. Board of High School and Intermediate Education consider providing an optional subject on environmental studies. Such a subject would draw from various disciplines, and would emphasize on man's dependence on the environment.

B. Environmental Studies Programme at the University level:

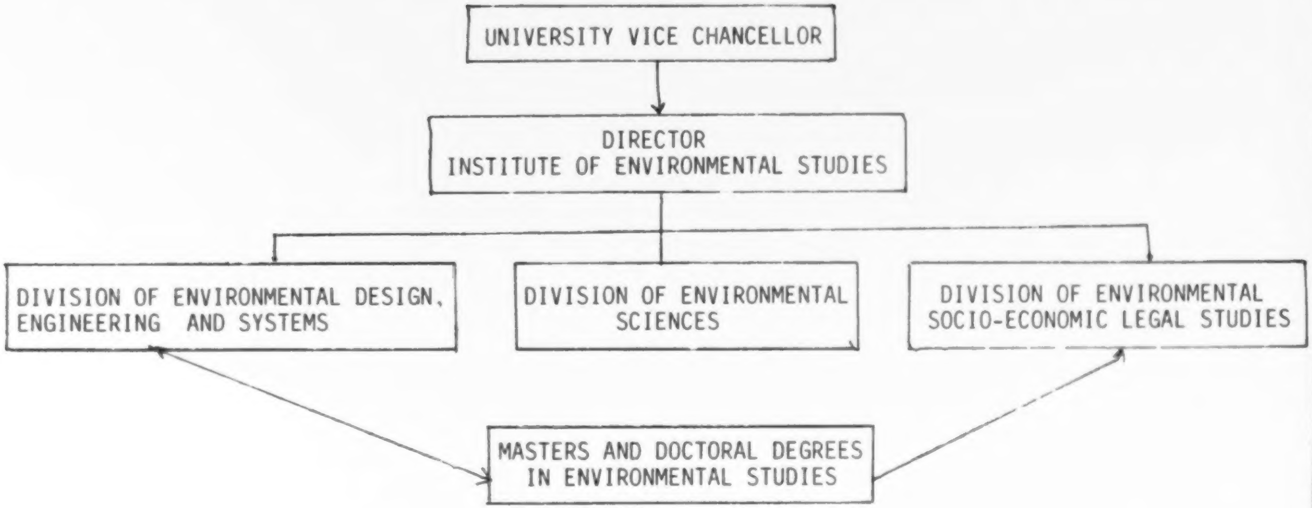
The visit to five main Universities (Aligarh, Kanpur, Lucknow, Banaras and Allahabad) plus the Indian Institute of Technology (Kanpur) revealed that no institution has developed a comprehensive environmental studies programme. However, in all universities, departments of Botany and Zoology are doing important and significant research and imparting postgraduate education. In the IIT (Kanpur), Institute of Technology (BHU), M.L.N. Regional Engineering College (Allahabad) and College of Engineering (Aligarh Muslim University), there are plans (and in some places there are already programmes in place) to offer environmental engineering courses. H.B.T.I., Kanpur has a special interest in environmental engineering, and is seeking cooperative linkages with other institutions in Kanpur.

An organisational structure (see chart I) is proposed for environmental sltudies programme at the university level. It is recommended that universities consider establishing an INSTITUTE OF ENVIRONMENTAL STUDIES which should have three divisions : (1) Divison of Environmental Design. Engineering and Systems to draw upon the existing strengths from the engineering and mathematical sciences, (2) Division of Environmental Sciences (to emphasize on natural and physical sciences including medical/health sciences), and (3) Division of Environmental Socio-Economic and Legal Studies, to draw upon the disciplines of economics, geography, political science, sociology, philosophy, law and languages. Irrespective of the fact from which division a student completes his specialisation, he would receive a M.Sc. degree (in environmental studies). And irrespective of their chosen areas of specialisation, all students will have to take at least two courses from the other two divisions. These subjects may be of one-semester duration only. But during their first year of studies, students should complete all required courses. The master's degree programme may be of three years duration.

CONCLUDING OBSERVATIONS

The basic and fundamental nature of environmental education is multidisciplinary and includes all factors related to environmental problems, the study of man-made and natural environment, and is concerned with total human activity and his environment. Thus environmental education refers not only to scientific problems such as contamination of water, air and soil, the detection, surveillance and monitoring of pollutants and their impact on human health and on all other species, but also to the socio-economic and legal aspects of controlling the damage done to the environment which grows out of our dependence upon technology. Consequently the social sciences, humanities and law constitute a most significant part of the total spectrum of environmental education since how man chooses to live, his values and beliefs, his interaction with others, and his economic activity, are intimately involved in causing of ecological problems and impose constraints which ultimately control the choice of governing institutions and enforcement mechanisms. Hence environmental education/studies programme must have holistic orientation.

We would like to state two basic premises as a part of our concluding observations: (1) In the next decade, 1985-95, it will be distinctly to the advantage of India to have prepared a new breed of professionally trained specialists who can be called 'envireonmental managers'. Such people should be experts in one of the three streams of environmental education programme (environmental science, environmental engineering and legal/socio-economic environmental studies), while possessing considerable knowledge of other streams in which he/she is not fully specialised. (2) In India, while the universities and similar institutions can and should be recognised units for advanced and applied research on environmental problems, the appropriate focus for the training of 'environmental managers' would have to be a separate facility, akin to the Indian Institutes of Management. A truly professional institute/centre is needed to fulfil the obligation of preparing trained professionals. In this respect, the plan by the Department of Environment/ Government of India to establish a National Institute of Environmental Management, is laudable and should be followed through seriously and immediately. Regarding the first premise, it is safe to say that no university in India has established an institute/centre/school which fulfils the


UNIVERSITY VICE CHANCELLOR
DIRECTOR
INSTITUTE OF ENVIRONMENTAL STUDIES
DIVISION OF ENVIRONMENTAL DESIGN, ENGINEERING AND SYSTEMS
DIVISION OF ENVIRONMENTAL SCIENCES
DIVISION OF ENVIRONMENTAL SOCIO-ECONOMIC LEGAL STUDIES
MASTERS AND DOCTORAL DEGREES IN ENVIRONMENTAL STUDIES

* Master's Degree Programme will require students from one area of specialization to take a minimum of four semesters courses from other areas.

Fig. 1. Suggested Structure of Environmental Studies Programme at the University Level

stated objectives.*

The visit to major universities and institutes in the State of Uttar Pradesh, Haryana and Rajasthan revealed that while many engineering colleges/institutes have strong interest in environmental problems, and while many departments of Botany and Zoology are stressing ecological subjects for higher studies and research and also in some medical colleges public health subjects include environmental, epidemiological and medical issues, the universities are yet to take up the challenge and to provide a truly multidisciplinary programme. Of course, here and there many adhoc and varied efforts have sprung up in various universities, and many good plans are afoot, there is a need to have a much more planned and organised approach to the question of environmental education and research by our universities and institutes of higher learning. It is recommended that the University Grants Commission, in consultation with the appropriate departments/ministries both at the Centre and at the state level, should formulate a policy and procedure which will help in deciding where and how an environmental education and research programme is to be established. A restricted policy approach would have to be followed if India wishes to spare itself from the hordes of unemployable environmental scientists and engineers. The opportunistic tendencies being exhibited by some universities need to be curbed. In this matter, state governments must be vigilant in the sense that they should encourage the establishement of schools/institutes/faculties of environmental studies only in a selected number of places. The example of medical colleges is a case in point. A word of caution should be stated here. In the West, when environmental studies revolution gripped the universities in sixties, many a places the programme ran in full-tilt into the vested interests of conservative and traditional science departments which provided maximum resistance to multi-disciplinary orientation for environmental education. The visit to universities in the State of Uttar Pradesh revealed similar tendencies.

We would like to offer some concluding recommendations:

a. Environmental education should begin at the primary level with compulsory teaching of the environment (what man has done to it, and how can we safeguard it for us and for future generations) going upto class X or higher secondary school level.

b. No under-graduate degree programme in environmental studies is needed. (The main reason for this statement is that due to the breadth of knowledge required, no degree of specialisation would be at all possible.)

*This statement, though general in nature reflects the status of environmental education programme in North Indian Universities, but the situation (as of February 1985) in other parts should not be different).

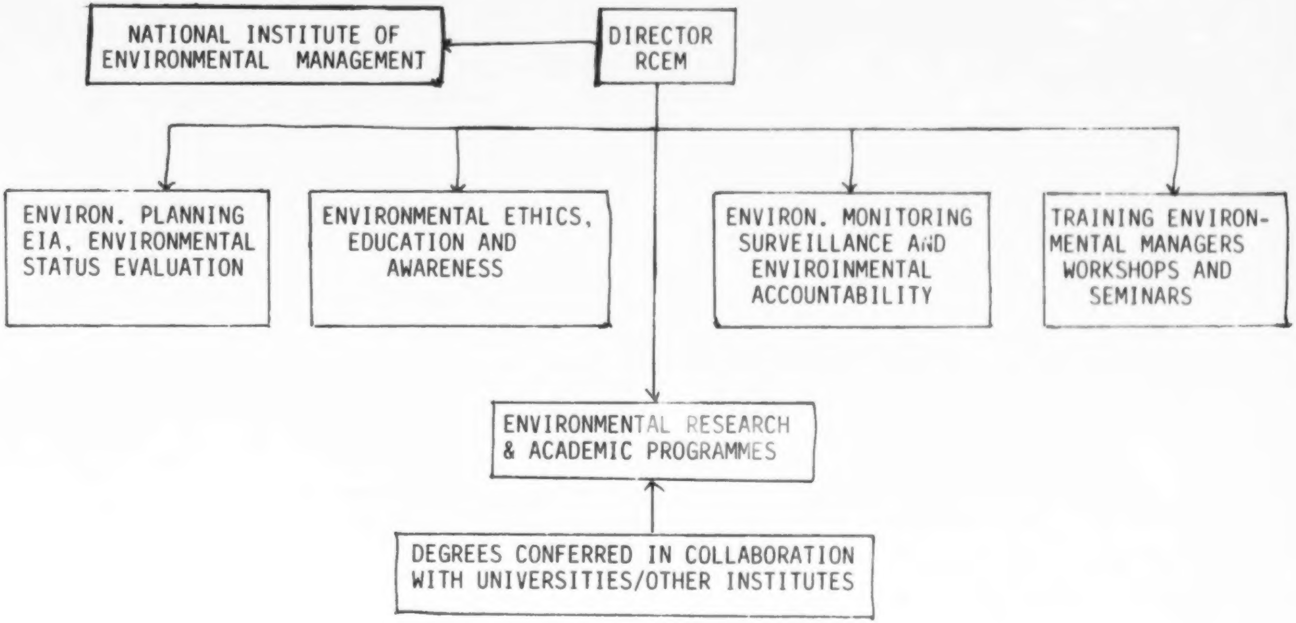

NATIONAL INSTITUTE OF ENVIRONMENTAL MANAGEMENT
DIRECTOR RCEM
ENVIRON. PLANNING EIA, ENVIRONMENTAL STATUS EVALUATION
ENVIRONMENTAL ETHICS, EDUCATION AND AWARENESS
ENVIRON. MONITORING SURVEILLANCE AND ENVIROINMENTAL ACCOUNTABILITY
TRAINING ENVIRONMENTAL MANAGERS WORKSHOPS AND SEMINARS
ENVIRONMENTAL RESEARCH & ACADEMIC PROGRAMMES
DEGREES CONFERRED IN COLLABORATION WITH UNIVERSITIES/OTHER INSTITUTES

Fig. 2. Suggested structure for a Regional Centre for Environmental Management

c. Natural Sciences, particularly Biological Sciences have been the traditional torch bearer of environmental education and research. However, it is they who also show the greatest resistance for opening up the programme to other disciplines. Any postgraduate environmental studies and research programme must be multidisciplinary in focus.

d. The Government of India should immediately approve the plan to establish a National Institute of Environmental Management. In addition, a network of regional centres for environmental management be planned to satisfy regional demands for training environmental impact assessment, environmental monitoring and surveillance, training and workshops, etc. (see chart II).

e. There is an immediate need to establish a task force (or a committee) to study and report upon the status of environmental education and research in India, and to recommend ways and means to give a concrete shape to the national vision to protect and conserve the environment and to upgrade the quality of life of the citizens of India. The suggested task force/committee should be established by the Government of India, and the terms of this body should include both the centre and state educational process. The task force/committee should visit countries of similar political institutions such as U.K., Canada, Australia in addition to visiting USA, Sweden and China. It is also suggested that services ofexperts from abroad also be used in addition to commissioning special reports/paper by specialists in India. And as universities, institutions of higher learnings, boards of high school and secondary education, and the state government ministries of education are rushing to introduce various kinds of environmental education programmes, it is imperative that this report be completed and printed before the academic year 1985-86 is over.

What India needs now is a fully developed comprehensive policy on environmental education and research. A national policy and programme is needed, so that the country is able to protect the environment, enhance the quality of life, and conserve resources for future generations. Immediate action needs to be taken on the sugestions and recommendations listed in this paper.

ENVIRONMENTAL EDUCATION

H.D. Kopardekar*

INTRODUCTION

Every living thing is interacting continually with its environment which consists of other animals and plants and its physical surroundings In the present world man is moving away from the natural environment and is more and more compelled to be in an artificial environment whether he is working resting travelling or recreating The ancient process of socialization of the child and bringing up the family involved living with nature and therefore much part of the environmental education was automatically taking place Some of the traditional rituals and religious functions and festivals in India include basic introduction to nature In the present situation it is necessary that environmental education is included at all levels of education from childhood to old age in the schools in excursions in colleges universities special nature exploration campaigns reading audiovisuals etc Children and youth have to be made aware about the importance of trees from school days Besides it is also necessary to include some understanding about the man made and built up environment in the system of education It is also more important to include the study of implications of all the activities of man which rapidly affect the nature which has a slow process to adjust and recover by itself

Some suggestions are made in this brief paper on various aspects of levels of education on environmental issues

NATURAL ENVIRONMENT

To understand the natural environment and nature s potential for adjustement after assault on its processes it will be necessary to cover following aspects in the study

a) How living things cooperate or the biosphere and the ecosystem the flow of energy and interaction between the species

b) How life zones are created or the combined effect of biological and physical factors (climate etc) water and life influence of rock and soil (mountain to sea) growth and succession of plants etc

c) Relationship between climate evolution and man s disturbing efforts in respect of ecological stability (forests and animals clearance by man for agriculture and settlement effect of rain and climate on bare landscape and eroding soils as also by elimination of certain species by hunting etc and nature s slow ability to restore)

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d) Life in various types of natural environments such as polar areas temperate regions grasslands tropical forests deserts coastal belts rivers lakes oceans isolated areas and evolution of new species etc

The details and contents will lay according to the nature of studies but an ecologist will have to study all these while a botanist zoologist chemical engineer forester civil engineer geologist may have to have a general background and more details of a particular aspect as listed above

HOW TO LOOK AT AND APPRECIATE NATURE

It will also be necessary for people living in today s artificial environment to educate them as to how to look at and appreciate nature One must understand how to allow the natural scene to take its effects on him and savour its special character and forget the other things on one's mind for a while. Nature and its rhythms will have to be properly grasped if oneness with nature is to be established for a short while Some organised excursions with experts showing how to concentrate and practice understanding of the nature enjoy its pleasure its colour and contour rather than interfere with it Nature could be an year round inspiration if people can develop an eye to appreciate it. see landscape in various seasons changes in colour and texture along with climate and effects on the animal life.

Education on nature will have to be a very important item on the agenda of environmental education This will help restore the composure of human beings and their relationship with their surroundings If people are educated in this way. they are less likely to take part in spoiling nature in their day to day life and while recreating on holidays etc

DEVELOPMENT PROJECTS AND ENVIRONMENT

It has been increasingly accepted now especially after the intervention of the World Bank. that environmental appraisal is necessary beforehand for the clearance for lending and approval to any major development project especially industry and most other large scale urban development works The problems that may be created originate from the possible psychological physiological and socio-cultural effects These effects vary from a hydroelectric project to an industrial or a large scale housing project. Industry power forestry. fishing. livestock. rural development transport and tourism all will present different types of implications.

Tools and techniques will have to be developed and experts trained in the study of the implications solutions to the problems and costing of such solutions in relation to their benefits. The training in appraisal techniques will be a highly skilled job by itself

The analytical techniques for study of sources and effects of industrial pollution effects on air water and land will have to be taught in relation to each type of pollutant its characteristics principal sources principal effects controls and standards or norms beyond which the pollution effect may be formed as hazardous Various types of gaseous liquid and solid wastes will have to be studied and analysed and their effects on life and environment will have to be properly understood by the "would be" controlling authorities

URBAN ENVIRONMENT

It will be necessary to educate planners architects engineers administrators and such other professionals. who are responsible to making proposals affecting environment especially creating (even disfiguring) urban environment. The topics that may have to be covered by a course for these professionals will be as follows:

a Urban environment in contrast to rural environment
b Perception or image of cities towns and settlements
c. Effects of zoning. densities heights and grouping of buildings and building byelaws etc.
d. Traffic and transportation street furniture and its impact on environment.
e. Effects of vegetation (trees grass and other plants) water bodies and wind pattern on the environment (measurement in terms of temperature lowering or air conditioning costs being reduced or dust content and CO content reduced by vegetation) f. Preservation of natural or scenic beautiful spots in cities and towns. regulations for their control etc.
g Techniques in environmental appraisal or Environmental Impact Statement (EIS) as developed in western countries.
h. Overall drainage patterns. hill ranges tree plantations. built up areas and their effects on micro-climate of particular areas and special steps to protect the environment and adverse effects on life
i Performance standards for industries for pollutants such as noise smoke dust and dirt odour toxic gases. glare and heat fire hazard. industrial sewage traffic and transportation. and aesthetic factors.

Suitable emphasis will have to be given on some of these aspects in particular types of courses for particular disciplines of professionals.

ROLE OF VOLUNTARY AGENCIES AND EDUCATIONAL INSTITUTES

Voluntary agencies have an important role to play in the field of environmental education because they are much closer to the people and freedom to work and access to the people as compared to the government agencies Voluntary agencies and educational institutes can take up programmes on environmental education on a large scale.

CONCLUDING REMARKS

This paper has very briefly outlined aspects to be covered in various types of Environmental Education courses from normal curricula in schools colleges to education and training for professionals and common people These may have to be discussed and specific proposals recommended to the respective authorities/ agencies and efforts made to bring out articles books etc for creating general awareness about environment among the people.

Specific action also will be necessary in respect of role of municipal and other development agency officials Separate courses will have to be organised for them as in service and induction courses. The culture which is generally developed with emphasis on "regulatory approach" will have to be changed to "development approach" which will considerably help in the matter of environmental protection and improvement.

PROJECT BASED TEACHING IN ENVIRONMENTAL EDUCATION

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The crucial aim of environmental education is the development of behaviour which is in accordance with environmental needs. This means to transform knowledge and experience into everyone s life Therefore environmental education should be related to the problems as they exist in the pupils' immediate living environment On the one hand, it should aim at finding concrete solutions to problems and on the other hand, at providing for the participation of teachers and pupils in a practice-orientated teaching and learning process (Habrich 1981).

What better way is there of achieving these goals in schools than by project-based teaching? The significance of this form of teaching has been under discussion in American and European educational circles since 1935 (N.L. Bossing 1935, and J Dewey and H W Kilpatrick 1935) In the seventies further books appeared on this subject in our country. But what is the situation really like with regard to the realization of this much-praised form of teaching? I have the impression that ever greater legal barriers new directives for the teachers the teachers own indolence. their job-oriented thinking and the retreat into the simple transfer of material has to a large extent prevented the application of project-based teaching in the schools of our country The performance of multidisciplinary projects is particularly prevented by the rigid organization of the school's day-to-day programme the division into subjects and the training of teachers to be specialists in only few subjects Most of all there are the problems of measuring achievement and assessment in project based teaching But to be honest the theory of project-based teaching is all quite nice, but in the real school life there is little room for those projects, often only in a mixed form and with restricted scope.

But happily times are changing. I have the impression that the new exciting task of environmental education has rekindled in many teachers and pupils an interest in the performance of site-based projects. This time the initiative has not come from above from professors of education but the desire is being expressed on the school front. Project reports on environmental activities in schools are coming from all parts of Germany. In our centre for Environmental Education in Essen we have already started a small collection of such projects It seems to me as if with the newly acknowledged task of environmental protection. new life has entered the schools It is my impression by saying that through the idea of environmental protection people have developed a new interest in the enviroment of their home districts in their immediate living spheres For this reason more and more teachers and pupils are concerning themselves with local topics such as the question of preservation of historical monuments and urban renewal. Particularly interesting in this connection is the work outside school and the feeling in all the participants of doing something "real" In fact many projects connected with environmental conservation are linked to concrete goals in the locality and in local policy. They often have clear tangible results: for example new tree plantations or cleared ponds.

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I would like to report on such an example in Dusseldorf: there we have the Jan-Wellem School where small-scale actions concerning environmental protection have been carried out for years For example, sections of the Rhine bank were cleared of garbage and a small marshy area was cleaned up. In the school there is a permanent "Environment Exhibition" in which the findings from the clearing actions are exhibited These activities gave rise to the permanent establishment of an "environmental protection working group" involving pupils from various classes and age-groups The work of this group has directed the attention of the city authorities towards the school.

Thus one day the following offer was made: the city of Dusseldorf had DM 5000 available for cleaning and saving a small marshy area. The city offered the work to various firms. None of these was prepared to perform the work for this price Finally the "environmental conservation working group" of that Dusseldorf school applied for the contract. There were a number of explanatory discussions between the pupils, teachers and the city administration. There was some doubt whether the pupils and teachers were capable of performing such a serious contract in a ,correct manner. Of course there is always enthusiasm at the beginning, but then ... Finally the contract was signed. The working group set to work the whole site was surveyed photographed and drawn. Equipment was obtained from other teachers and from parents. The father of one of the school-girls provided a small truck for carrying away the garbage. The remaining work had to be postponed until mid-September so that the amphibious life in the mud could be spared up to that point. A pensioner who was familiar with ther area first played the role of spectator but later became an active member of the group. He had a lot of time. good knowledge of the area and practical skills And so various generations, pupils, teachers people in the neighbourhood and the city's forester were involved in a joint action. The work lasted several months (see W. Henz and B Strecker 1981)

The local press was repeatedly kept informed over the whole period and they were eager to take up the topic. Moreover the action even became known all over North Rhine-Westphalia when the Minister of Education reported it in his journal. This example became famous but many other projects of similar kind are not mentioned in the press The special character of the Dusseldorf project lay in the realism of the undertaking it was not just a play project but indeed a serious "commercial" matter The fact that it was paid for imposed a certain obligation. It was not possible for anyone to quit simply because he didn t fancy it any more With the sum of money available the city administration achieved its goal and was grateful for this valuable assitance. Educationally, much more had been achieved: the combination of school and non-school tasks. It is hardly possible to imagine a more meaningful school project even in the educational sense We only have to think of the many educational "side-effects": integrated work (surveying drawing photography biological records plants and all sorts of physical work on the site) handling equipment involvement of other teachers, of parents, of people in the neighbourhood etc. group work press work education of the public. work with the authorities cooperation between different generations etc.

Some teachers spontaneously took on the difficult task of managing such a project without having read the specialized literature on project-based teaching. They simply began and they learnt by experience. Often it is successful. Sometimes however, a lot of time and effort is expended with very little result The result may also be frustration and irritation between the pupils and teachers. and contempt from the authorities.

For this reason it is perhaps eminently advisable to remind oneself of some of the basic ideas concerning teaching projects. There have been decades of experience described in many reports in the specialized literature. Precisely at this point where this teaching method for environmental education has achieved a new significance we should take up the experience of others and see what we can use in particular for a modern applied environmental education.

Basically the teaching project is to be seen as a jointly planned project on a clearly defined topic involving the interest and the responsibility of the whole of the working group It is related in particular to reality and oriented to the real life outside school This definition gives special emphasis to the involvement of the pupils even at the stages of selection and initial planning of the project This "pupil co-determination" is the only way of achieving a high level of identification with the task. The selection of the topic and the preliminary planning is extremely important The purpose is the correct estimation of one s own abilities.

Another definition of project-based teaching emphasizes, as an essential didactic condition breaking down of the subject-based timetable to create an undertaking which has to be regarded and treated in an integrated fashion In this way conventional subject teaching is broken down and learning becomes a more lively and true-to-life process. built up as it is on natural interest. The teaching matter. which is often abstracted out of reality is seen and experienced once more in its real context. Here again the teacher becomes familiar with the subject by himself.

He has to transcend subject boundaries himself and ask other colleagues for assistance and cooperation. In order to prevent integrated work on the teaching project from slipping into mere bungling or lack or professional competence. even into downright error the factual and professional competence must be ensured to a certain extent.

For all the realism of a project it must be said that in most cases the out-of-school reality is only present in outline. This is also acceptable. The long established educational task of achieving a model picture sets a whole range of limits to practical work. however and precisely in the field of detecting environmental damage: certain scientific matters, such as pollution of the atmosphere can very often be not presented in a simple way with regard to their consequenes and causes It is often even more difficult here for pupils to obtain model readings by means of their own measuring methods Similar things apply with regard to social and other cultural questions

In the specialized literature we also read of the experience that neither the teacher nor the pupils should begin immediately with a large project It is important that as early as many weeks and months before in the course of quite "normal" teaching individual sections of work involved in project-learning should be practised. Then small tasks should be given to the pupils These tasks should also have the character of a project and be dealt with outside the school by the pupils To summarize then: beginnings should be small and modest and take the form of steps which can be grasped Pupils, colleagues of the staff and parents must be trained.

The example of the Jan-Wellem Scholl in Dusseldorf shows that a group prepared in this way can achieve extraordinary things further on.

Another objective of project-based teaching is as follows. It is less important for the pupils to enlarge their factual knowledge by means of a project than to train their skills and particularly their behaviours until they meet the needs of the environment This goal applies more for the first environmental projects than for those that follow: if environmental awareness has already been built up in the initial projects then in the later ones the emphasis can be more on factual problems. This is what the pupils themselves demand.

In project-based teaching individual pupil is an integral part of the group as regards the working and learning process. He learns collectively and not alone or in competition with this fellow-pupils. He is not under the pressure of individual assessment Together with his group he determines the scope and speed of the work himself. But this great advantage of the project also means that weaker or even unwilling fellow-pupils have to be carried along: this is quite an acceptable goal of social training. No teacher will be able to avoid intervening now and again in a running project. The reality of the pupils is often not up to the ideal situation described in specialized literature.

Not least among the institutional conditions required in projects is that the school is well equipped, and in particular when tests and measurements of scientific nature are to be performed in environmental teaching.

Modern technical instruments for such things as noise measurement or determination of environmental chemicals are especially expensive. It is also necessary that pupil laboratories are available. Even the cost of paper for questionnaires and copying costs should be considered In addition there also have to be adequate facilities for documenting the results of the projects: slide and film shows, poster displays. etc

In conclusion, let us look at another example of a successful project on environmental protection. The special feature here is that the pupils themselves produced a book on the project. This book is available and is the basis for the following project description which I have taken from a thesis (Christine Seelig: Ecology in religious instruction? University of Bochum 1980) The book written by the pupils is entitled (translated into English) "Trees die quietly, Pupils fight against the death of trees" The school is located in the German city of Ravensburg. which has 40,000 inhabitants and is located 20 km north of Lake Constance, an old imperial city of mediaeval character.

The project began like this: the teacher suggested the general theme for the school year: "Growth of population and crisis in the environment" Following old habits he wanted to present preformulated sub-topics for selection. The class was not enthusiastic and gradually as the first spontaneous activity on their part, they came to the conclusion that they wished to work as a group.

After a brainstorming session subtopics arose which the pupils certainly preferred to those originally intended by the teacher: "Problems of waste disposal in Ravensburg" or "Death of trees in Ravensburg", etc. The theme of the death of trees was certainly sugested on the basis of concrete, negative experience. Seven working parties were formed The pupils determined the procedure themselves, the teacher gave help now and again.

First several members of the group "Death of trees" investigated, with the use of a city-map the condition of the green areas and the tree stock. Later one of them photographed particularly good and paraticularly bad examples.

Gradually the pupils developed according to their own statements, an eye for where savings were being made on planting, where trees had been felled and for what reasons.

At the same time tried to obtain information material from competent non-regional offices and institutions; for example on such questions as directives on the preservation of trees in cities, damage to trees by vehicle exhaust gases, planting of trees in planning permission etc. Here the pupils had their first encounter with the authorities: they received four letters in which, the competence for answering the questions was shifted from one office to another and finally they were referred to local authorities. "Anyway, we now knew all about the rough path of officialdom ... that there is no central body which draws up guidelines according to which the local authorities should work. Every local body has to muddle through ... " (Frey, Stottele, Weichert, 1976 p 16).

When visiting the local Building authority remarkably, they saw a dead tree in front of the door After a conversation with the person responsible for the matter they knew no more than before. They realized that they first had to acquire basic knowledge and stated that they should be better informed in order to manage such an actual topic as environmental protection (Frey, Stottele Weichert. 1976 p 17).

In working out this knowledge they learnt about things which went far beyond their theme and which concerned general environmental problems: the sinking of the groundwater level, the sealing of the soil by construction work, atmospheric pollution... The tasks of trees within the overall ecological context (for example production of oxygen) and its significance in our damaged environment (collection of dust cleaning the atmosphere lowering the temperature) came into view, and moreover the problems of conurbation (Metropolitan Areas).

An opoinion poll was also started with questionnaires drawn up by the pupils themselves. The group summarized that the population had no remarkable environmental awareness.

Finally the group of pupils even found courage to approach the city authorities suggesting improvements. They discussed with local politicians the necessity of planting trees in the city and preserving existing trees. Indeed as a result of this debate new trees were planted in some places of the city. But also bitter realizations had to be faced:

- there is indeed no money available for nature,
- cities are built to do justice to motor cars and not to people
- there are disputes over competence within the authorities and these result in nothing being done

After a concluding opinion survey however a glimpse of hope appeared: the individual citizen is now at least more interested in the problem than the authorities.

During the course of the work the pupils continually became aware of group problems and these had to be cleared up These problems are also explained in the book under discussion here. The result is that certain improvements are suggested for other projects of the same kind.

After passing their graduation examinations at the school the class planted a chestnut tree. As a result of this joint work two pupils made up their choice of profession: they studied biology and ecology respectively.

In conclusion the group said: "Since we have been dealing our topic we see trees and green areas with completely different eyes, we have achieved a relationship with them" (Frey, Stottele, Weichert 1976, P. 53). Overall the awareness was gained "that criticism and involvement either move things or they show the barriers that remain irresistible. In the school "an absolutely exceptional situation was created". The pupils were able to realize themselves by debating among themselves and with others: "an experience which, hopefully, will provide impetus for further development."

The pupils determine their way of proceeding, according to the principle of trial and error. this can teach them skills for later activities of this kind outside school.

Learning and living do not, as generally in school, separate from each other. Learning is connected with actions which had successful results even outside the classroom (new green areas).

Finally it becomes apparent that here the demands are not only placed on the pupil with regard to parts of his personality but on the pupil as a whole person: the pupils themselves notice that in the last analysis they have learnt cognitively (knowledge about environmental problems and dealing with the authorities), socially (group dynamics, dealing with fellow-citizens) and also emotionally (relationship to nature, and here in particular to trees).

The success of their project can be the basis of their hope for further involvement in the future.

SUMMARY

Project-based teaching has as its foundation the following principle:

- self activity of the pupils at the planning stage
- reduction of teacher dominance
- problem-oriented learning and action
- multidisciplinary learning
  independant acquisition and review of knowledge
- intertwining of in-school and out-of-school reality
- group work
- product orientation (demonstrable concrete results)

- individual responsibility and involvement on the part of pupils
- behaviour modification (specifically for environmental matters)

Project-based teaching which is directed in this way and is often performed outside the school building has been praised in specialized literature since 1935. In the reality of Germany schools. however it plays a relatively minor role Institutional obstacles as well as the indolence of many teachers are the causes.

With the emergence of environmental topics in schools within the framework of environmental education there seems to be a considerable revival of project-based teaching. Environmental conservation projects in schools are continually published. Some of them are presented in detail in the local and regional press. There they also provide a significant impetus for the creation of public awareness. Two examples are described in this paper: from the large city of Dusseldorf (cleaning and saving of a marshy area) and from the small town of Ravensburg (trees and green areas in the city).

Finally I would like to give you a quotation from a participant in a teachers' in-service training conference (G. Putz) on the theme "Environmental Education in Projects":

What we are concerned with is "Life" in schools.
Ideas are important, to promote action.
Nothing works without involvement.
If there are no initiatives then all projects die.
Quality cannot be organized.
The important thing is not schemes, ideas, theories but involvement. Where should we make a start?
Should we offer models or introduce new elements into teacher training? What we want to achieve emotionally in the pupil should already be present in the teacher.

(quoted from: W. Habrich and E. Kohler 1981).

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ENVIRONMENTAL EDUCATION PROCESS
(Suggested action programme)

Agencies	Target Groups	Purpose and Aspects to be covered in the process of Environmental Education.	Mode of Education
Primary Schools	Young Children	Creating general awareness about Environment and Nature and importance of cleanliness, protection of trees etc.	Demonstration and field visits handling some natural products and play.
High Schools	Children	Creating awareness about dependence of man on nature, about ecosystems, animal and plant kingdoms.	Demonstration and field visits Audio-visuals observing growth of trees, Actual involvement in campaigns.
Colleges	Youth	Imparting clear understanding of principles of Ecology, Population growth and impact on resources, nature etc.	As above, and in addition direct involvement in tree plantation and protection and in cleanliness campaigns and in campaigns for health and sanitation programmes.
Colleges and Universities	Youth in Post-graduate courses	Promoting analytical approach and Research projects concerning relationship in environment and man	Research and studies, besides above modes
Voluntary agencies	General public	Creating awareness about health and sanitation, protection of evnironment and role of citizens.	Audio visuals, campaigns, Demonstrations, field visits.
Officials agencies Local bodies	Representatives of people, and administrators	Creating awareness about Environmental planning and control policies in other countries,	Meetings, Seminars, Distribution of Books, Journals, Reports, Audio Visuals.

ENVIRONMENTAL EDUCATION IN JAPAN

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INTRODUCTION

Along the process of industrialization and modernization, severe destruction of the environment has occurred in Japan to the extent of damage to human health and lives that the word Kogai, expressing heavy pollution, has become internationally known. With a view to reduce pollution, there has been much effort made towards environmental education.

Environmental Education in public education

In the framework of traditional formal school education, environmental descriptions were scattered among various textbooks on language, science geography, history, social studies, and so on. In 1970's, the existence of pollution was finally written in the textbooks to some extent, but its description was made as simple as possible. Without dwelling on the causes, it was described as past incidents which were solved successfully by the effort of the industry and the government. Under a strict censorship of the government, the description of war and pollution were the most critical items where the Ministry of Education tried to rewrite the drafts frequently. During the past one century, the attitude of the national government was always regarding pollution issues as security problems, and this attitude was refelcted in formal education. The description of environmental problems in the textbooks is superficial, and it is difficult to get the general picture of Japanese environment from the school textbooks.

In spite of such strong regulation of educational contents, there have been many active cases of true environmental education at the grass-root level, by the school teachers in primary, secondary, and high schools, on local pollution and other environmental problems everywhere in Japan. They are the best environmental scientists in this country. The contents of the education is starting from some certain items such as science and social studies, naturally and inevitably becomes an interdisciplinary and synthetic study. A part of such local studies are reported in the annual research conference of Japan Teachers Union, and this conference is a good information source on pollution studies.

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Since mid-70s, as the environmental disruption and pollution became so visible and it was one of the most urgent domestic issues in Japanese politics, the national government established the departments of environmental science and technlogy in a dozen national universities. But the content of these departments is a mosaic of existing sections of science and technology related to the environment, such as botany, zoology, sanitation, landscape, gardening, and so on, generally too fragmentary and technical. There was no originality in theory and methodology, so they remained at a low level. Many avoid to touch the actual problems under their eyes, arguing they are too political and difficult. On this point, better work has been done in the field of social sciences in general.

Environmental education in the industry

There are two categories of environmental education in the industry, One is the training of engineers for the certification of pollution prevention, by individual industry or a group of them. By law, each factory larger than a certain size should hire an engineer with a certificate of pollution prevention, which is issued through a national examination. This training is mostly technical, and there is little component of social and historical science, but it is the largest effort of the industry in this field.

Another is the public relation activity of the industry for surrounding local residents, emphasizing how much attention is paid for the protection of the environment by the industry. A large sum of money is spent for the purpose to prepare the books, pamphlets and films. For long time in the process of industrialization of Japan, the industry did not need special effort for public relation because its social image was so high with the contribution to the employment and the local economy, in spite of some negative problems such as pollution and labour accidents until 1960s. But the behaviour of the industry in industrial pollution in 1960s and in the oil crisis in 1973, greatly harmed the social image of the industry, so in 1970s, it needed some investment into public relation to increase its social image, and the environmental issues were included naturally in this effort.

The government sponsored NGO's are working in the same field as the industry. They have generally much money, but the activity is rather limited, because they can not criticize the government and the industry. Many teaching materials are prepared by these NGOs for the public relation of the governmental policies.

Informal environmental education by NGOs.

Perhaps the largest part of Japanese environmental education, both in quality and quantity, is the informal education in NGO activity. The degree of environmental disruption has been so severe that a special word "Kogai" was commonly used in daily conversation and administrative jargon for heavy environmental pollution damaging human health. For any NGO activity against Kogai is needed continuous self-education within the NGO, because of strong power of the industry and the government which caused Kogai. A considerable part of the history of anti-pollution movement was also the history of educational movement. Already at the end of last century, in the history of Ashio Copper Mine Poisoning incident, Tanaka Shozo, the leader of anti-pollution movement of farmers, requested to the young farmers in the movement to study the population of each village, to count the birth and death statistics in the villages, for the evaluation of health effect of mining pollution. The level of statistics for the decline of birth rate and the increase of death rate was quite high at that time, and useful for the movement and the education of young farmers.

The anti-pollution movement of Mishima and Numazu against petrochemical complex project in 1964, was supported by the scientific study of local conditions by inhabitants, led by local high school teachers, and ended in success. The relationship between the operation of petrochemical complex and its pollution was studied carefully, and an environmental impact assessment was prepared by local people. People studied micro-meteorological survey of the area with May carp flag. More than 300 study meetings were held among local people, to learn and exchange the knowledge of pollution before the final rejection of the project. Since the success of this movement, informal environmental self-education became the necessary condition for the success of environmental movemnt, and in most movements, the leaders are local school teachers, and they are respected locally as grass-root scientists in spite of rather poor payment. Their work is reported in the annual research conference of Japan Teachers Union, and the meeting provides a good chance to know the general picture of Japanese pollution. Vegetation and coins are good indicators of pollution; even the detection of radioactive leak is measured by the measurement of gene mutation in the flagella of stamens of spiderwort. The informal education by NGOs is forming a kind of national network. Anti-pollution movement is actually a self-educating movement led by school teachers, of lower middle class, giving some impact to local politics. Also there are many local nature conservancy movements such as bird watchers and nature lovers, and several hundred movements are forming a national network in Japan Union of Nature Conservancy.

The Experience of Jishu-Koza

As a typical example of environmental education movement, I would like to describe my own experience in Jishu-Koza, Kogai-

Genron, pollution theories, which were a kind of voluntary lectures in the University of Tokyo. It was started by a research assistant in 1970 as a night class for citizens, to study the basic principles of Japanese pollution and to find the ways to stop or reduce pollution by the movement of citizens. Like European private dozent, the lecture was open to public in the vacant class-room in the University of Tokyo by a young assistant. Everyone could enter the class after depositing small money (100 Yen), but if the lecture is not interesting, or if it is not understood, one could request for the refund. This is a traditional way of some public amusement in Japan. The fee was used for the preparation of the lectures, such as printing. The lectures were quite successful, and volunteers came out of the audiences to help the preparation and the management of the lectures. They worked for the recording of the lecture, then the recording was printed and published, for ten volumes of books, and sold in the market. More than 200,000 copies were sold in total, and they became the textbooks for anti-pollution movement all over Japan. In 1972, the citizens committee of Jishu-Koza sent the delegation of pollution victims of Minamata disease and Kanemi Rice Oil disease to Stockholm UN Conference on Human Environment, to expose the severity of Japanese pollution, to give warning to the whole world. The committee was also working as a focal point of informal network between many local citizens movement, distributing the information and the experience on pollution. More than 300 lectures were held, sometimes inviting the victims, researchers, administrators, journalists, politicians, and other social components related to pollution, and perhaps several thousands of people attended the lectures in 15 years. Since 1973, the importance of international cooperation was noticed, and the publication of English Kogai Newsletters were started. In 1979, Jishu-Koza held the first Regional Seminar for Asian Environment, in cooperation with Indian Environmental Society, and revived the activity of Asian Environmental Society, which was formed in 1971 but had became dormant after several years of activity. Jishu-Koza was closed in 1985 after 15 years activity, for several reasons including the change of status and working place of the initiator, but many activities which were started by Jishu-Koza, are developing as independent movements, and remain active hereafter. The information center activity of Jishu-Koza will be succeeded by JUNC. In general, the initial purpose of Jishu-Koza was an emergency expedient for violent acute type of industrial pollution, so more long-term measures for nature conservancy should be formed in a more stable organization.

The experience of Jishu-Koza is that even an assistant can prepare a suitable field, the citizens are able to organise themselves in the self-educating activity, and can achieve much more in the prevention of pollution than a department of University system. It gave also a possible way of university reformation and revitalization of higher education system in informal environmental education.

Effect of the Environmental Education in Japan

Japanese environment was greatly polluted in 1950s and 60s, and recovered to some extent in 70s for various reasons, but the largest reason was the local movements by the victims and the citizens. It was supported by aforementioned self-educating activity of local inhabitants. Here we see a great achievement of environmental education in Japan.

Many of movements by local people were against gigantic and excessive plans of industrialization and development, resulted in a slow down of Japanese industrialization process, and the ironic stabilization of the industry after 1973. This was a kind of negative participation into political process by resistance. In Japan, we had so many cases of pollution in past, so it was possible to have general theory of pollution by the critical analysis of cases to find the cause of the failure.

Japanese pollution control laws and local ordinances were prepared by the pressure of the movement of victims and local citizens. They have punishment clause and applied to the worst industry in some cases, so they were surely quite effective in the actual education of the industry in the prevention of pollution. Punishment is a part of education, so it is effective as a part of environmental education for the industry. Even civil court cases were effective to reduce pollution because the issue gave social damage in the image of industry, and some degree of prevention and reduction of pollution was forced on the industry.

In this process, the role of mass media was very large. Most of Japanese media are commercial, and vulnerable to the pressure of strong industry. But in most cases of pollution, the issues were the problems of social injustice and many journalists worked in the cause of justice to report the issues. Even commercial media had to report pollution issues inspite of the pressure from the industry. Also many independent journalists, and artists worked especially in visual art such as photographs, pictures, films and so on. Local movements published various pamphlets and small magazines, and educational, scientific facts were always important part of the contents.

Problems in Theory

Until now, the pressure of industrialization and modernization has been so strong in Japan, the negligence and relinquishment of tradition has been so hurried, that the traditional natural ideology of animism and Eastern relativism of Buddhism were forgotten, and they were not used for synthetic understanding of nature. Especially this failure is seen in higher education, in the stagnation of environmental education in the universities. The environmental education is a mosaic of past divisions it is too economic, utility oriented, and it regards the nature only as resources. Its content is fragmental reductionism. Until now, synthetic ecological viewpoint of nature and world is in the process of formation, and it will take some time to establish. Past frameworks of academism and industrialized science were powerless to understand the nature and the environment. In my 25 years experience, academic methodology which was obtained in the university was too powerless. Facing the reality of Minamata disease, I had to start from an engineer, learn local economy, sociology, and legal science through action. Hereafter, the environmental sciences should be formed and learnt through action in a transdisciplinary way.

In many scientific conferences in Asia, frequently I had the same question, what is the role of intellectuals who learnt western science and its value system, in the Asian traditional society. The conclusion from own experience is that it is the role of travelling merchant carrying experience and information, and the role of good actor for expression. It is necessary to choose proper theory which matched the needs of local conditions, and the technique of performance.

Future of Environmental Education

It is now clear that academic science and its successor, industrialized science are both powerless for the detection and solution of the environmental problems. Now it is necessary to develop a kind of life science or service science, a reassembled system according to the needs and the necessity of people. It will be a quite different system from previous ones.

I propose to reassemble liberal art courses of university system, using my own experience in Jishu-Koza in informal environmental education. For instance, the social science students, who constitute 70-80% of Japanese university students, have few chances to use in their life mathematics and chemistry which are now taught in the liberal art course. These natural sciences can be rearranged into an environmental science in transdisciplinary way, it will be an important initiative for future activity as managers and bureaucrats. In the same way, students in natural science and technology, need environmental study within modern history and the history of science and technology, to understand the social and cultural side of science and technology. The contents of education will be more action oriented, and problem solving way, than in the present system. Students will understand the importance of transdisciplinary study of the environment. Simple facilities of the science laboratory in common secondary schools which are available everwhere may be exploited for such studies.

ENVIRONMENTAL CHALLENGES AND THE STATUS OF ENVIRONMENTAL EDUCATION IN PAKISTAN

Mohd. Aslam Khan*

INTRODUCTION

Pakistan, the ninth biggest nation of the world in terms of population size has immense fragile mountainous, semiarid and desert areas whose productivity is already under serious environmental threat. Moreover, a major part of its 90 million (1983) rapidly growing population lives in near total dependence upon a delicately-balanced water management system drawn from the biggest irrigation system of the world. With this geographical background and predominant agrarian economy in which agriculture sector accounts for almost a third of country's GDP (29%) employs more than half of the population (55%), and earns over two-thirds (29%) of the country's export earning, it is imperative that Pakistan's capacity for environmental management and its ability to approach its resource exploitation sustainability together with environmental education must be treated as inseparable elements in attaining future prosperity.

This paper is divided into three sections. The first gives the general environmental setting and briefly discusses the environmental problems facing the country. The second section evaluates the overall policy response to environmental problems. It discusses the national mandate and major environmental actions taken so far. The third section reviews the status of environmental education in Pakistan highlighting the current setup of courses, institutions and mechanisms as well as future strategies in both formal and informal sectors.

ENVIRONMENTAL SETTING

Pakistan occupies the basin of the easternmost of the three great rivers that traverse the steppe desert of the Old World, the Nile, the Tigris-Euphrates and the Indus. That these basins were the cradles of early civilization gives to the Indus a distinctiveness that is missing for other river basins in South Asia. Emerging as an independent nation of the world in 1947, the country's territory extends from 24°N to 37°N lat. and 61°E to 75°30'E long. For management and administration, it has been divided into four provinces namely Baluchistan, Punjab, Sindh and North East Frontier and two federally administered regions. Each province is further divided into divisions, districts, tehsils, cities and mauzas (revenue villages). The two federally administered regions are tribal areas bordering North West Frontier Province, commonly known as F.A.T.A., and Federally Administered Capital Territory (F.A.C.T.) of Islamabad.

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Physical Setting

Physiographically Pakistan can be divided into three major units: the northern mountains, the western highlands and the Indus plain. If two imaginary lines are drawn on the accompanying map (Fig. 1), one from Khyber pass to Islamabad and another from Islamabad to a little west of Karachi, then roughly the northern mountains are north of the first line, and the Western highlands to the west of the second line, and the Indus plain to the east of the same line.

The northern mountains are the meeting place of three great mountain ranges of the world, the Karakoram, the Himalayas and the Hindukush. Virtually all elevations here are higher than 3,500 m above sea level, more than half are above 4,500 m and more than fifty peaks are above 6,700 m. The area also abounds in glaciers, some of which are the largest in the world, outside the polar region, of course. These glaciers feed the Indus river and its tributaries which form the life line of Pakistan's irrigation system. The vast drainage area of the Indus corresponds roughly to the provinces of Punjab and Sind. The Indus plain in Punjab varies from about 150 to 300 m and consists of fine alluvium deposited by the Indus, and its five tributaries, i.e. Jhelum, Chenab, Ravi, Sutlej and Beas. Southward in Sind, the plain differs in that it is lower in altitude and was formed by the deposit of only one river, i.e. the Indus and the alluvium here is of more recent character. The Indus plain is bounded on the west by highlands which are lower than northern mountain in altitude and are also relatively more arid. The aridity increases in these highlands as one moves from North West Frontier Province in the north to the Baluchistan province in the South. Pakistan is basically a dry country of the warm temperate yone. Great climatic differences prevail from the northern mountains down to the seacoast in the extreme south, but the country's general climatic character is one of aridity. Annual precipitation except in the northern highlands averages less than 250 mm, decreasing from north to south and the country's agricultural baseis largely dependent on the extensive system of irrigation by canals. In some areas where irrigation water is not available desert conditions prevail as in Thar desert (Fig. 1) and extensive parts of Baluchistan.

Biotic Setting

In the scheme of IUCN classification of the biogeographical provinces of the world, Pakistan falls under two major realms, i.e. the Palaearctic realm comprising the northern and western mountains, and the Indo-Malayan realm extending over the eastern lowlands and the Himalayan frontiers in the north. The realms also have a variety in their biogeographical provinces. The

Palaeractic realm has five provinces, i.e. Himalayan highlands, Hindukush highlands, Pamir Tianshan highlands (north), Anatolian-Iranian desert (western mountains) and also Iranian desert (Baluchistan), whereas the Indo Malayan realm has only two provinces, i.e., the Indus-Ganges mountain forest in the North (Himalayan foothills) and Thar desert (lowland).

The habitat as can be seen from the above varies a lot. The natural vegetation grades from coniferous forest in the north to mixed scrub forest desert vegetation and mangroves in the coastal area. Less than six percent of the country is forested and large proportions of the forested area are under private ownership.

Economic Setting

The economy of Pakistan presents a picture which is broadly the profile of what United Nations statisticians describe as "Middle Income Developing Country". The country's industrial sector including large and small scale manufacturing constitutes 17% of GDP, with an industrial labour force estimated at 3.5 million and manufactured exports accounting for 65 % of the total exports. During the course of economic growth, the share of agriculture in GDP has fallen by almost half, from about 55% in 1948 to 29% in 1982-83. This has not accounted for any agricultural decline. On the country, the agriculture sector has been growing steadily and often rapidly, particularly after Green Revolution. It is in fact the result of doubling in the share of manufacturing and an even more pronounced increase in organized industrial sector large scale manufacturing mineral construction, electricity and gas the shares of which have grown from 4 to 22%.

The country has indeed progressed from the first phase of industrialization focussing on consumer good industries to more sophisticated basic and heavy engineering, glass, chemicals, chemical fertilizers, ship building, assembly-cum-manufacture of cars, trucks and rolling stock, telephone and telecommunication equipment and a host of other engineering equipment and components. Pakistan's first steel mill started partial production in 1982-83. The charge in Pakistan's economy has also been accompanied by rapid pupulation growth which has doubled itself within the last 23 years, at an average annual rate of 3% per annum. One concomitant of the population growth is its uneven distribution. Thus compared to rural population urbanization has proceeded much faster at 4.3% to 4.7% per annum doubling every fifteen years. According to 1981 census, out of a total 83.8 million people, 28.6 million or 28% are living in urban places. Amongst the urban dwellers 54% live in eight largest cities and 48% in about 400 remaining small towns. The 60.2 million rural people (72%) live in 44,000 villages spread all over the country. The overall literacy rate is about 30%, which is higher in urban sector and is also higher amongst men compared to women.

Environmental Problems and Issues

The pattern of past agricultural and industrial development in Pakistan has largely been through mismanagement of natural ecosystems and has created many environmental problems including pollution of soil, water and air with their consequent costs to human health and well-being.

A number of country's problems have emerged from resource misuse. Short-term interests have put a great strain on environmental carrying capacity. Rapid increase in population and its unbalanced redistribution has been another reason for environmental degradation and increasing miseries of human settlements. The declining population resource ratio and ensuing poverty, likewise, has affected the quality of life. What is worse is that certain types of development have themselves contributed to pollution and made the problems even greater. The situation has become so enmashed in a vicious circle that it is not possible to separate cause and affect clearly or to establish dividing lines for example, it is difficult to establish whether the actions of poor lead to environmental degradation or the lowered environmental carrying capacity leads to poverty. Nevertheless, it is obvious that indiscriminate use of natural resources can lead to increasing difficulty is maintaining supply and lowering the standard of living. The solution therefore lies in a broader concept of wise utilization of resources.

Looking at the problem from another angle, both lack of development and the process of development have contributed to environmental problems in the country. The people of areas with low level of development, motivated by short term exigencies of survival have been neglectful of the long term exploitative actions on the environment. The affluents of developed areas, on the other hand, motivated by the incentive of capital investment and higher returns have promoted increasing consumption of resources. The result in both cases has been the same i.e., exhaustion and degradation of ecosystem. It is therefore not the question of whether to develop or not to develop but rather how to develop in a sustainable way to meet the multiple national objectives.

POLICY RESPONSE TO ENVIRONMENTAL PROBLEMS

Pakistan emerged as an independent state in 1947. The governmental policy towards environment during this phase can broadly be divided into three periods. The first period lasted from 1947 to 1960 during which the environmental problems remained almost totally neglected. The second period lasted from 1960 to 1972. Environmental problems during this period were tackled in isolated and ad-hoc fashion and no attempt was made to see these problems in an ecosystem perspective. The final period started from 1972 and continues today. This period initiated after the United Nations Conference on Human Environment in Stockholm (June 1972* which effectively marks the beginning of a concern in Pakistan for environmental management with broad perspective on a national scale.

Environmental Concern 1947-1960

From 1947 to 1951, the Government of Pakistan was preoccupied totally with the formidable problems of restoring normal economic commercial and communication systems and channels of the new nation as well as establishing new central and provincial government organisations. The government prepared its first six years development programme (July 1951 to June 1957) in great haste and it was incorporated into Colombo Plan. The programme to be quite precise did not suggest any major administrative change, economic reform or environmental concern. It was actually a hasty grouping of schemes. In later years, the First Five Year Plan (1955-60) tried to initiate the concept of physical planning but it was still limited to housing in general and settlement of displaced families (which had migrated to Pakistan after independence) in particular. The other aspects of environment remained by and large neglected. The main thrust of planning was towards linear economic growth and development of social services and the programmes for inducing modernisation in rural life lagged behind improvements in physical output.

Environmental Concern 1960-1972

This period is marked by a considerable expansion in the country's industrial sector, introduction of green revolution in agricultural sector and completion and launching of mammoth irrigation projects such as Warsak, Mangle and Tarbela dams and initiation of Karakarom Highway Project (from Pakistan to China). Unfortunately no environmental impact studies were made of these projects and the general attitude like the previous period was that of laissez faire. It was believed that the best form of development takes place under the minimum regulation. Nevertheless the emergence and expansion of environmental problems in the wake of exploitative use of resources and growing population did receive some acknowledgement. Remedial actions, though not in a concerted and systematic manner, were undertaken to combat the growing problem of soil pollution by waterlogging and salinity. Through SCARP (Salinity Control and Reclamation Project), a large part of deteriorated land was recovered. Considerable importance was also given to soil erosion. A soil survey department and a forest research institute were created to carry out studies on forest and soil conservations. A large scale family planning programme was also started to curb the rapid population growth.

Some studies and action also started in physical planning particularly in large cities like Karachi, Lahore and Peshawar, etc. Likewise rural development also received some attention through introduction of a local government program. Each of these actions related to improvement of the human environment or resource conservation in one form or another. However these still remained isolated actions and the fundamental premise that the national development should not be wasteful and that resources should be utilized as trust for future generation was still not recognized. Despite the induction of a system of local government in the development process, the quality of life theme did not receive recognition.

Environmental Concern 1972-1985

The period 1972-85 marks a major breakthrough in the attitude of both people and government of Pakistan towards environmental preservation. Before 1972, the communication media remained virtually silent and perhaps was blissfully ignorant of the subject of pollution and environmental hazards. Today the newspapers are replete with the stories drawing national attention to continual environmental degradation. Even casual reading of the newspapers particularly the sections dealing with letters from the readers reveal growing pollution. A radom sample would include complaints against the alarming effects of wastes discharged from certain industrial projects, against industrial odors and unbearable noise in residential areas as well as unsatisfactory sanitation. The scientific societies and learned bodies are also holding open forums, seminars and symposia to highlight the environmental problems andk issues. The Scientific Society of Pakistan in one of its session focussed on the state of the Quaide Azam Mausoleum (most important national monument) resulting from the onslaught of air pollution in Karachi. The number of research papers dealing with different aspects of environmental problems and issues have also increased proportionally in the scientific journals of the country.

The increasing awareness of environmental degradation has shown visible impacts on the governmental policies and programmes. As stated earlier there were certainly a number of steps taken prior to 1972 to individual problem areas of Pakistan's environment such as waterlogging and salinity, deforestation, siltation, fisheries and wildlife etc. but the idea that such isolated concern should be evaluated and coordinated under broader perspective was one truly significant outcome of the Stockholm Conference. The federal government took up the issues raised in Stockholm and directed that an immediate examination be made to the steps which should be taken to meet the threat to the human environment in Pakistan. Subsequently the Ministry of Presidential Affairs convened a meeting of experts concerned with various aspects of environment in November 1972. A major outcome of this meeting was the formation of a committee on Human Environment to make necessary recommendations. The committee submitted a report in April 1973 making a number of recommendations. The report stressed that the magnitude and complexity of the problem of environmental degradation required an urgent attention and needed dealing in a comprehensive manner. It called for a two pronged approach embraching both the long-range preventive and short term curative measures, so that economic development would not produce ..."chaotic human environment, poor living conditions and serious degeneration of the environment".

Another major positive development of 1973 was constitutional mandate for the preservation of environmment. The federal focal point of general environmental matter was also gradually strengthened. The function of looking after general environmental matters was entrusted to the Ministry of Production, Industries, Town Planning and Agrovilles in 1972. However, the Ministry of Science and Technology looked after many issues dealing with general environment. A new Environment and Urban Affairs Division was created within the Ministry of Housing, Works and Urban Development in 1975 and the responsibilities for all general environmental matters were shifted to this Division. The efforts of this division have helped in the enactment of Environmental Legislation of Pakistan in December, 1983. This act has resulted in the creation of an Environmental Council of Pakistan with the President of the country as its Chairman. The council will supervise the efforts for safeguarding the environment and approve the environmental policies, an important input within which would be the sector of environmental education.

ENVIRONMENTAL EDUCATION

Present Status

The subject of environmental studies is not taught as a separate discipline in elementary or higher education at present. The existing system has "infusion approach" based on incorporation of environmental education within the appropriate traditional subjects. The idea is to avoid adding another subject to the already congested school curriculum. At graduate level, the need for an interdisciplinary course in "environmental studies" has been growingly realised as an ideal situation but the limited job opportunities in the existing set up have prevented the establishment of a separate graduate programme in the field. Untill now it is taught as an elective course in Biological or Natural Sciences. The situation in out of school forum or non-formal education is the least satisfactory. In a country where only a little more than a quarter of the population is literate the ecological or environmental education, in past had a narrow range of strategies. These included agricultural extension programmes and wider outreach techniques through the use of mass media. The biggest drawback has been the lack of infusion of environmental education in the adult literacy programme. Likewise no effort was madeto create environmental awareness through national campaigns.

Regarding the institutions and mechanism for planning and development of environmental education at undergraduate level the responsibility lies primarily with the Directorates of Education, Text Book Boards, and Boards of Intermediate and Secondary Education. The Ministry of Education, and Provincial Education Departments provide guidelines and technical expertise if required. They also coordinate activities at provincial and federal levels. Planning and development of curricula for graduate education falls under the purview of the Universities. University Grants Commission acts as national coordinator at this level. In each case formal education courses are designed by the committee of experts and approved by the relevant board of studies and other appropriate bodies. Non-formal education is handled primarily by the Literacy and Mass Education Commission (LAMEC). Environment Division, Government of Pakistan, although not involved direcly in curriculum planning for either formal or informal education, does play important role in the diffusion of basic concents through its guide books, etc.

The concept of environmental education has undergone great change in Pakistan during the last few years. Starting from hygiene and health education to biological ecology, it has made a beginning in the right direction by accepting the totality of environment. Today the accepted definition of environmental education in Pakistan encompasses natural, man-made, ecological, political, economic, technological, social, legislative, cultural as well as aesthetic aspects of environment. Despite this, the opportunity for active learning is provided only by the more narrowly defined environment such as public health. The shift of emphasis is not yet reflected fully in the curricula. Further, the courses in formal environmental education have neither been intergrated at various level, nor micro associations have been developed to show properly the linkages that exist between the local, national and global environment. By and large, the concept of "One Earth" or "Spaceship Earth" has not been adequately emphasized inthe environmental education curricula. The situation however is likely to improve in near future with the concerted efforts for dissemination of knowledge through teachers' guide books and manuals being prepared under the aegis of the Environment Division, Government of Pakistan.

Future Strategies

Efforts are being made to make the environmental education more meaningful and integrate it at various levels. Material on environment being taught as a part of learning package at school level is to be reviewed to create, familiarity with the basic concepts of family, home, school and neighbourhood. The linkages of broad components of environment and their importance in local, national and global perspective is also to be emphasized. The following programme has been conceived for the improvement of environmental education at school and secondary level.

a. Review of curriculum to include two to three chapters on environment in each class within appropriate subjects.
b. Development of relevant teching/learning material.
c. Pre-service and in-service training of teachers.

A special or integrated option has been envisaged at the upper secondary level. In this connection, the University Grants Commission recently constituted a group to help develop a model inter-disciplinary course in Environmental Studies at graduate level. Beside, examining the possibilities of establishment of separate departments/institutions of Environmental Studies, the group recommended three-pronged attack to promote and improve environmental education at graduate level. These included teaching of environmental studies as a diploma programme, a distant learning course in Open University; and a subject coordinated elective course in the Master's programme of Universities.

All future strategies of formal environmental education in Pakistan emphasize on learning through activities centred on real life situation. Likewise, in the future strategy for non-formal education the main objective is to help pupils to improve the quality of their life. Emphasis again is on competancies which students can use in solving of problems encountered in daily life.

Problems and Prospects

There are numerous problems in the implementation of strategy for the improvement of environmental education. These include deficiency of experts and training material particularly relevant to local conditions. This is more so in the case of informal education, which is extremely impotant for a country like Pakistan, where vast majority of population has not been exposed to formal education. Despite these constraints, it is encouraging to note that the Environmental Education is about to cross the take off stage. Instructional materials are being prepared and training programmes are being arranged. A teacher's handbook on the Environmental Education is to be published soon. Realising the importance of non-formal education, the Environment Division, Government of Pakistan, is also making special efforts to develop material on non-formal education to be used by the mass media. The division has also planned to launch systematic and sustained in-service training programme in Environmental Education. Side by side, the Literacy and Mass Education Commission is striving to encompass effectively various aspects of environmental conservation in its mass literacy campaign.

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OPPORTUNITIES AND CONSTRAINTS FOR TRAINING ECOLOGISTS AND ENVIRONMENTAL SCIENTISTS IN SRI LANKA

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Ecological approach to planning and development is now widely accepted as a sound pathway for harnessing the natural resources of a country for the betterment of its people. Sri Lanka has a rich, varied and interesting fauna and flora. It has a variety of tropical habitats- natural and man made- of immense scientific and aesthetic value, forming an important part of the national wealth of the country. This tropical island with an area of ca. 65000 sq. km has well over 3600 species of vascular plants. The flora is also unique in having as much as 25% of endemic ferns and flowering plants. The island is also bestowed with bountiful water, mineral and animal resources. Its climate, physiographic features and geological history have largely contributed to the rich and interesting wealth of plants and animals.

The first recorded collection of plants of Sri Lanka was made by Paul Hermann during 1672-1679 and these were catalogued by J. Burman in his Theasarus Zeylanicus in 1737. Hermann's collection was confined largely to the neighbourhood of Colombo. C. Linnaeus arranged Hermann's plant collection according to his proposed system and this work was published in the form of a catalogue under the title Flora Zeylanica in 1747 (see Abeywickrema 1959). Sri Lanka has the unique distinction of having some of the plants named by Linnaeus according to his binomial system. Linnaeus was able to determine about 429 taxa leaving 228 species undetermined.

In the early nineteenth century, Moon (1824) compiled a catalogue of the indigenous and exotic plants of Ceylon, and arranged them according to the Linnaean system with their local Sinhala names. This catalogue comprises 1127 species of which 164 were considered new to botanical science. The catalogue also included 366 cultivated plants.

The next eminent and serious student of Sri Lanka's Botany was G.H.K. Thwaites. His botanical studies culminated in the publication of Enumeratio Plantarum Zeylaniae (Thwaites 1859-1864). This extremely accurate and important publication formed the basis for Henry Trimen's (1893-1900) comprehensive 5-volume handbook of the Flora of Ceylon. The Handbook still remains the only complete description with keys for the identification of all

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the recorded flowering plants of Sri Lanka. It is considered as one of the most comprehensive floras of a tropical country.

Taxonomic studies were not pursued for well over half a century after that until Abeywickrema (1959) produced an updated check list of the Ceylon Flora. In more recent times there has been a renewed interest in taxonomic studies and these were initiated largely under the auspices of the Smithsonian Institution in 1968. This programme had as its target complete revision and updating of Trimen's monumental work. During the past 16 years, four volumes have been published and these cover 50 angiosperm families (Dassanayke and Fosberg 1980-83). It can now be said that the plant life of Sri Lanka has been studied and well documented for over two centuries by foreign and local naturalists and taxonomists.

For a serious student embarking on ecological studies well documented checklists and identification manuals are available. The student is also fortunate in having a variety of relatively undisturbed natural habitats for pursuing the ecological studies. While the lowlands have a temperature ranging from 25 to 30 °C, the Central highlands have a more moderate mean temperature approaching mild temperate climate. The south-western region and the central highlands receive a rainfall ranging from 200 cm to 500 cm while the extreme north-west and the southeastern parts of the island experience well marked dry periods where the annual rainfall is between 75 cm and 125 cm. Sri Lanka has the added advantage of having 9 of the 10 major soil types.

One would have considered that all this would form potential areas for very fertile ecological studies. However, there has been very limited ecological work during the Colonial and post-independence periods. The few ecological studies carried out by foresters and their vegetation classification have limited ecological value. The very few studies that have been carried out using numerical and analytical techniques are restricted to man-made grasslands (Holmes 1951) some forest ecosystems (De Rosaryo 1950) and a salt marsh (Chapman 1947). Estuarine mangroves, fresh water marshes and wetlands have not been hitherto subject to modern ecological analysis.

The accelarated river valley development programme embarked during the past two decades brought large areas under cultivation. The new human settlements and agricultural areas present many social and environmental problems. These newly opened land areas and the major agricultural, industrial and urban settlement programmes together with the free trade zone have laid a firm foundation for the sustainable growth as well as for improvement of the quality of life of our people. We have made massive investments in providing infrastructure facilities essential for the life of the community such as irrigation, power and water supply. All these projects need careful and continuous monitoring and study in detail. Such studies have been pursued but at a very low key partly due to lack of awareness among decision makers and partly because of the tremendous dearth of suitably trained personnel.

As is the case of most countries basic ecological and environmental training has to be imparted by tertiary educational institutions. However, this is seriously hampered by the shortage of qualified teachers and researchers at our Universities. Our enumeration shows that there are not more than 6 trained ecologists in the 9 Universities in the island. To this figure even if one adds on those working on what may be considered as the peripheral areas of ecological science, the total does not exceed 12. Thus, the lack of trained manpower is the major constraint restricting training and research in ecology, seriously hampering environmental assessments on developmental programmes.

Recent Government policy quite rightly demands that an environmental impact assessment be made available before embarking on any major developmental or industrial undertaking. This makes it all the more necessary to increase the output of graduates equipped with ecological knowledge and skills.

More recently (1982) a Central Environmental Authority was established. Some of the middle level posts at this Authority are now manned by a few who have been trained under the Masters Programme of training in Environmental Science provided by the University of Colombo. This Post-graduate programme was considerably assisted and partly funded by the British Government under their overseas development assitance programme. Foreign assistance continued for a few years and it is now left for Sri Lanka to put in the necessary inputs for the continued success of this programme.

It is recommended that

(a) The dearth of trained ecologists and environmentalists be remedied by an immediate expansion of the facilities available at Colombo and other selected technical and University level Institutions. The programme should be able to enroll about double the present number. There should also be a review of the curriculum followed by periodic evaluation gearing the training to meet the environmental needs of the country for which it caters.

(b) Undergraduate students be encouraged to pursue studies in Ecology and Environmental Biology by making them aware of employment opportunities. On employment such graduates should be given special incentives if located in remote villages or when working in development projects in difficult stations.

(c) The planning for education, research and training in environmental sciences should be so done that all the disciplines would get their proper place in this pluridisciplinary science. This is a necessity at all levels, secondary, tertiary and higher schools. Our system of education for some reason or other does not permit this as nothing appears to leak out from one another.

(d) Short-term courses for revamping the techniques and skill of bioscience teachers in the teaching of ecology.

(e) Production of books and materials be strengthened.

(f) Presentation of popular articles on ecology in the language assimilable to the public.

(g) Exchange of teachers preferably from the region for Postgraduate programs.

I am sure you would agree that any education, ecological or environmental education being no exception is meaningless unless it reaches grass root levels - and that being the common man. In order to achieve this we must always remember that an important interphase exists between scientists and decision makers. We must exert considerable tact to keep it alive at all times. Finally let us remember the words of Rene Dubos (1969),

> "We shall soon experience an environmental collapse unless a grassroot movement makes it imperative that public and scientific establishments give high priority to the study and control of the forces that are rapidly making the earth a place unfit for human life ".

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ENVIRONMENTAL EDUCATION IN FEDERAL REPUBLIC OF GERMANY

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PART A GENERAL ASPECTS

Administrative and Constitutional Fundamentals

Like most of the European countries the Federal Republic of Germany has been participating in the global UNESCO program Environmental Education from its very beginning As a result of the conferences in Belgrade and Copenhagen and finally of the 1977 conference in Tbilisi environmental education made itself heard and attention was paidto not merely by pedagogical research but also by administrative bodies In the Federal Republic of Germany public schools are in the responsibility of various Federal Ministers of Education In a joint conference in 1980 these ministers decided to declare environmental education as compulsory upon the curricula of German schools Consequently, more and more environmental curricula were integrated into the schedules of the various school subjects Already in 1978 the Federal Government s Council of Environmental Experts had fundamentally been integrated into the natural sciences at the schools of the Federal Republic of Germany biology geography and chemistry Correspondingly it must be the task of the immediate future to intensify the impact of environmental education on the curricula of social sciences by promoting pedagogical and didactical research by establishing constitutional frameworks and by encouraging the producers of school media and textbooksto support such a development

Public and Private Institutions of Environmental Education

Nearly all federal ministries particularly the ministries of education and of agriculture and environment have departmental referees for environmental education at their disposal At German universities the following scientific institutions are working on environmental education

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directed by Prof Dr Reinhold E Lob and
Institute for the Pedagogics of Natural Sciences University
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Besides these institutions that both contributed in the UNESCO Programme on Environmental Education from its beginning various scientists at German universities are devoted to environmental education The Federal Agency for the Environment which is subordinate to the Federal Ministry of the Interior provides the UNESCO information department for environmental education. And finally there are the great organisations for the protection of the environment that formed working groups on environmental education and regional and local organisations deal with environmental education at schools and as part of adult education.

Principles of Environmental Education

In our country environmental education is regarded as an education in the face of the survival crisis of the industrial society and it is aiming at a fundamental and lifelong change of the people s awareness and behaviour towards the protection of the environment.

Environmental education has to comprise the education at preparatory primary secondary and trade schools as well as adult education activities public relation and the press media It is however, not the task to establish environmental education as a new school subject among the traditional ones. but the aspects of environmental education are regarded as to be integrated into curricula already existing and developed in the future so that environmental education shouldnot be perceived as an additional or separate but as an integral aspect of education. This system initiated promoted and fostered by governmental and university activities proved to be so effective that today a broad wave of environmental awareness can be recognized on all levels of education

PART B SPECIAL ASPECTS

Environmental Education in Schools

Not only as a consequence of the UNESCO program Environmental Education the governments of the German Federal States implemented environmental topics in the classical school subjects geography biology and chemistry being the most important. Particular efforts must still be undertaken as far as social sciences politics history. the fine arts. theology and philosophy are concerned.

This is rather symptomatical of the state of awareness of environmental problems in our country. The aspects of technology and natural sciences are acknowledged. promoted and supported by lots of money educational aspects remain on the seamy side We are still so optimistic to believe that the problems could be solved by environmental engineering We seem to ignore that only man s changed awareness of the environment is the essential basis on which technical and scientific means can be put into operation. A lot of work has still to be done in our schools enlarging social sciences by environmental aspects.

The many applications to our institution give us a notice of the activities of the school teachers We have got the impression that there is a lot of interest because both teachers and pupils are constantly asking for working materials Very often however we are not able to answer the requests comprehensively but confine ourselves to deliver current publication lists The pupils are working on projects to reduce energy consumption they lay out ecological school gardens clean up ponds and remove garbage from creeks. We very often receive project reports worth distributing all over the country to avoid unproductive parallel work But as stated before we are not able to follow all requests from pupils and teachers because a larger and efficient information centre is still missing We often regret not being ableto support engaged teachers in a way they should be supported

Working Materials on Environmental Education

Quite obviously. the publishers of text books and working materials for schools have recognized the boom, but the contents of their products underlie official regulations That is why the standard textbooks are running behind the demands for a modern environmental education and geographical or biological text books of about 250 pages very often offer only 25 pages dealing with environmental topics "Environment" is still a topic among others in textbooks as well as in the official regulations the requested impact on all school subjects has not yet been realized But moreover the purposes of many representations in schoolbooks must be critisized very often it seems to be intended only to transfer environmental facts but not to change the environmental awareness As for garbage for example it is asked how a dump is managed but not what the causes of the high amount of garbage are and what can be done against it. But it must be clearly stated that first of all the natural sciences began to tackle environmental topics

This seems to ensure from the fact that for the time being. environmental education has been adopted by the natural sciences as geography biology and chemistry. Their inclinations determine the working materials believing that a multitude of facts may change the pupils environmental awareness Even if this belief is not based on solid grounds from a pedagogical or psychological point of view. it must be the aim of an education in the face of the global survival crisis to change man s behaviour in order to protect the environment.

Besides these critical remarks it can be stated that the scope of text books for schools were recently enlarged by various didactical means and media of any kind produced and distributed by traditional publishers but also by environmental initiatives and other relevant organisations but there are also the industries supporting these efforts by various materials The general trend is to provide teachers with worked out lessons accompanied by working sheets and other media directly applicable. This material is completed by case studies of general relevance.

Problems in Teacher Training

Unlike some other countries in Europe and overseas the Federal Republic of Germany does not commit the teachers to join training courses after having passed their examinations. With regard to environmental education and to environmental problems that become more and more critical it must be crticized as dangerous that the instructors and educators of the next generation, living in a rapidly and hazardously growing world first have to realize the problems and new tasks by themselves.

Numerous training courses have been established by official and private institutions and are to a remarkably great extent attended by teachers a greater impact should however be achieved in the future Because the engaged teacher has so many chances in our country to enlarge his knowledge of environmental protection it remains to be seen if a voluntary and personal engagement is not to bring about better results than a compulsory teacher training would do

The Increase of Environmental Activities at Universities

Reviewing the catalogs of seminars and lectures of the different disciplines at German universities one gets the impression that environmental topics have an increasing impact also in this field for more and more courses of studies take up aspects of environmental protection Even if corresponding to environmental education in schools. the natural sciences geography and biology, are still leading social sciences and give increasing preference to environmental aspects Theological courses are held on "Man s Responsibility for the Lord s Creation" political seminars discuss "Strategies to Succeed with Environment Protecting Technologies": in history the historical relations and development trends of man s impact on nature are regarded All these activities show gratifying approach of the German universities towards environmental aspects.

Classical subjects as landscape architecture, landscape ecology gardening and agriculture are remarkably enlarged by environmental aspects Despite of financial problems new courses of studies came into being as for example Environmental Chemical Engineering Ecological Engineering at the University of Essen, and Town and Country Planning with special reference to environmental protection. Even if these activities cannot be regarged as environmental education in a narrow sense they show that German universities have open ears to the interests of environmental protection.

Environmental Education in Adult Education and in the Media

Numerous private organisations and hobby groups as e.g. allotment gardeners, have enriched their training programs by environmental education and achieved a remarkable response by their members. And it is particularly pleasing that the consumer's behaviour is more and more influenced by environmental aspects Newspapers as well as the broadcasting and television systems present regular features on environmental topics make relevant suggestions to change the behaviour and integrate increasingly environmental aspects into entertainment. It must be clearly stated that there is no general trend continuously to present shocking environmental problems but the individual possibilities to change the behavioural attitudes shall be made evident The public is not inclined to be bothered with horrifying environmental problems after a hard day of work and additional to the political and economic problems. It was asked if environmental education could not be integrated in shows or other entertainments may be even in thrillers First approaches have been made and were accepted by the public.

Environmental Education in Agriculture

Some years ago the European Council at Strasbourg established the working group 'Environmental Education in Agriculture and Forestry' that is also joint by the Federal Republic of Germany It is its task to enable environmental aspects a broader impact on agriculture and forestry nationally as well as internationally. In the Federal Republic of Germany it is intended to improve the curricula of agricultural schools by environmental protection and environmental education. First and satisfying results have already been presented by the Rhenish Agricultural Chamber that commited its schools to raise the proportion of environmental aspects in some subjects by 13 to 25%. It is intended to enlarge these proportions in other agricultural schools throughout the Federal Replublic of Germany.

Looking at agriculture as a whole three fields suitable to environmental protection and environmental activities can be recognized

1 general information and training activities in the scope of local and regional agricultural societies,
2. the agricultural school system, and
3 the agricultural press.

How the aspects of environmental protection and the environmental awareness can be enlarged in agriculture is currently evaluated by a research project of the Centre for Environmental Education in Essen This will be the basis to support the efforts of the federal and national institutions and ministries.

CONCLUSIONS

Retrospectively it can be stated that after eight years of discussion about environmental education in the Federal Republic of Germany good progress has been made as far as the natural sciences at schools are concerned. The other sciences should be promoted similarly in the future and basic research is recently undertaken. An other aim will be to encourage field studies and research projects at schools and environmental education centres.

And there are the training schools of the Federal Republic of Germany where environmental education has recently been enforced. As in agricultural schools, environmental aspects are being integrated into the schedules and curricula Outside school it can be recognized that environmental protection activities have grown in number as far as adult education and professional training courses are concerned.

Of particular importance however is the growing environmental awareness of the media that provide as wide range of reports of what kind soever. The dominating tasks of the near future will therefore be to foster environmental protection and the willingness to environmental behaviour all over the economic and political life in our country.

ENVIRONMENTAL ISSUES IN THE CARIBBEAN: AN EDUCATIONAL APPROACH TO TACKLE THEM

E.C. Laurent*

The islands of the Caribbean Sea are made up of a long arching chain which stretches from Cuba in the West to Trinidad in the South (Fig. 1). The colourful history of this sub-region has resulted in a variety of ethnic combinations, languages, dialects and ideologies that make this one of the most interesting regions of the World. Over the past five centuries, these islands have been governed for varying periods of time by the European Colonial powers like England, Spain, France and Holland. In more recent times, however, most of the islands formed part of the British Empire while the other powers retained some influence in certain territories. When agitation started among the colonies of the British Empire for Independence, the British islands of Caribbean and the British Colonies of Central and South America inevitably made similar demands. Between 1962 and 1984, twelve of the seventeen British Colonies of the region became independent. These include Guyana (formerly British Guyana) on the South American mainland, Belize (formerly British Honduras) in Central America and the Bahama Islands off the coast of Florida, United States of America. English has been maintained as the official language of all these countries (Table 1).

With the advent of Independence, the new countries of the Caribbean were faced with the stark reality that the earning of foreign exchange was absolutely necessary for survival in the competitive world. Traditionally, their economies were based on agriculture with the export of producee to European and, to a lesser extent, North America. Mineral resources played significant roles only in Guyana and Jamaica with their bauxite reserves and in Trinidad and Tobago where petroleum was mined since the latter half of the nineteenth century and refined since the early twentieth century. One of the simplest solutions to the foreign reserve problem was to invite investment from outside the region with a view towards industrialization.

One common incentive was the fact that the possibility of environmental degradation would be completely ignored by the inviting Governments. The industrial companies of the developed countried did not hesitate to explore the opportunities given to them because of the tax reliefs, relatively cheap labour and

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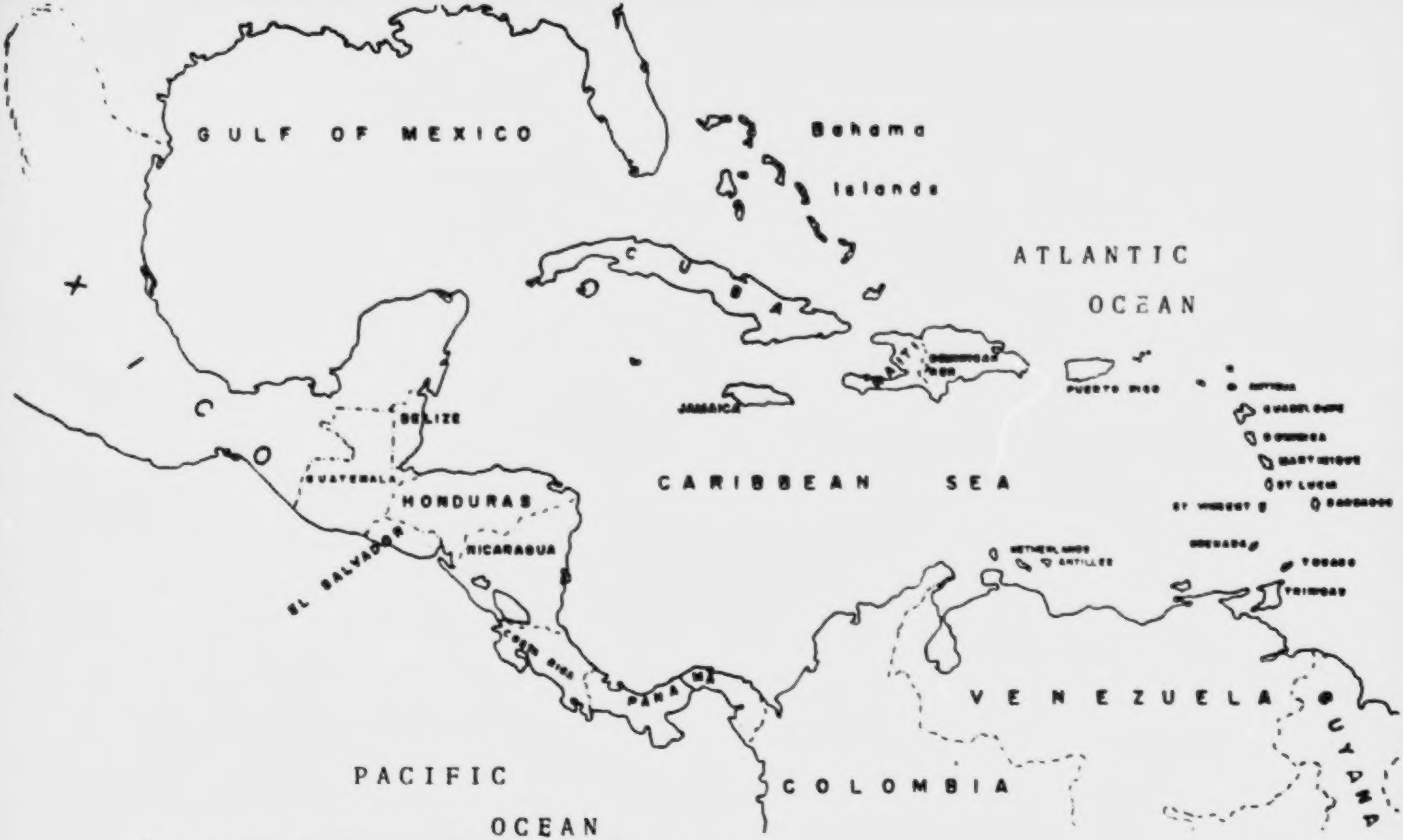
GULF OF MEXICO
Bahama Islands
ATLANTIC OCEAN
MEXICO
CUBA
HAITI
DOMINICAN REP
PUERTO RICO
ANTIGUA
GUADELOUPE
DOMINICA
MARTINIQUE
ST LUCIA
ST VINCENT
BARBADOS
GRENADA
TOBAGO
TRINIDAD
NETHERLANDS ANTILLES
JAMAICA
BELIZE
GUATEMALA
HONDURAS
EL SALVADOR
NICARAGUA
COSTA RICA
PANAMA
CARIBBEAN SEA
VENEZUELA
GUYANA
COLOMBIA
PACIFIC OCEAN

Fig. 1. The Caribbeans and the surrounding region

TABLE 1. Countries and their population in the Caribbean region (from Pan American Health Organization/World Health Organization- Population and Vital Statistics Report 1984)

Country	Approx. Population
Anguilla	8,000
Antigua and Barbuda	78,000
Bahamas	200,000
Barbados	254,000
Beliye	145,000
British virgin islands	11,000
Cayman islands	17,000
Dominica	74,000
Grenada	110,000
Guiana	800,000
Jamaica	2,000,000
Montserrat	12,000
St.Kitts-Nevis	45,000
St. Lucia	101,000
St. Vincent & Grenadines	124,000
Trinidad and Tobago	1,200,000
Turks and Caicos Islands	7,000

apparent lack of environmental awareness which existed in the host countries. It was also realized that the natural resources of sunshine and beautiful beaches could be explcited by the tourism industry because of the possibility of a steady inward flow of foreign exchange almost all year round.

One ofthe more obvious advantages of colonial rule in the English-speaking Caribbean is seen in the educational status of the population. While free scondary and higher education were available, in the colonial era, only to the academically elite, primary education was compulsory. The sub-region can now boast of an average literacy rate in excess of ninety percent with a range of seventy to over ninety-five percent. The University College of the West Indies was established in Jamaica in 1948 as a College of the University of London. This Institution became the autonomous University of the West Indies in 1962. There are now campuses in Jamaica, Barbados and Trinidad and Tobago. Emerging from this Institution and from many extraregional ones there have been many professionals who have returned to their native countries and are making significant contributions in the public and private sectors. Among these professionals are those who, because of travel or because of available literature or because of communication with their colleagues in developed countries have become acutely aware of the environmental degradation which has been taking place as a result of industrialization, tourism, lack of public awareness or just plain complacency on the part of the general population which, in the days of colonialism had grown accustomed to somebody else, somewhere else, providing them with their basic requirements.

It soon became obvious to professionals in the Public sector, e.g. Engineers, Public Health Personnel, Educators, Economists, Chemists etc. that there was urgent need to convince decision-makers and policy-makers that environmental management must be considered alongside developmental plans because, contrary to the beliefs of many people in authority, such management and development can be effected together. The big problem was, and still is, that in many aras the degree of deterioration is such that the cost of restoration is almost prohibitive if this cost is to be borne solely by the Government. The advent, in the Caribbean after independence of certain International Organizations, e.g. Pan American Health Organization/World Health Organizations, (PAHO/WHO), United Nations Environmental Programme (UNEP) and a host of others, with whom the "Environmentalists" could identify, served to catalyse the movement towards environmental awareness. Grants and fellowships became available for research and training and advice could be obtained by Governments to assist in drafting of legislation and the establishment of the necessary infrastructure for organised approaches to environmental management.

Meanwhile, professionals in the private sector engaged themselves in the formation of various organisations which attempted to function as pressure groups seeking environmental reform. These groups, however, have so far failed to motivate the communities which are directly affected by obvious lack of concern for the environment. The efforts of these groups have been encouraged to a large extent by the fact that the International Organizations strongly advise that community participation is an essential ingredient for the success of environmental planning. While such advice is not debatable, there is a crying need for the evolution of a formula to rid communities of developing countries of the complacency which now permeates them. It is unfortunate that very often it takes a disaster to cause an awakening of such communities. It is more unfortunate that some communities do not appear to learn from the experiences of others.

It is accepted in the English-speaking Caribbean sub-region that Environmental Education must play an integral role in Environmental management. Environmental research and legislation are both geared to contribute towards the educational process. It is appreciated that any education programme must be aimed at every stratum of the society so that management will include restoration, as far as possible, and protection, to prevent further deterioration. Programmes which have been developed, and which are still being developed are aimed at the primary, secondary and tertiary levels of education. Since the approach must be intersectoral one, professionals are getting together to provide coordinated programmes. **Decision makers and policy-makers are being provided with factual** information and with the pros and cons of various alternatives. The education programmes in the region are problem-oriented at the present because of the need to influence the attitude of the various segments of society.

The most obvious factors which contribute to environmental problems in the Caribbean are as follows :

1. Most Caribbean countries are small island states with limited land resources.
2. The countries have become independent only recently.
3. The need for foreign capital and absence of mineral resources in most cases have caused the Governments to promote industrialisation and tourism at any cost.
4. Mineral resources, where they exist, have been traditionally exploited with no regard for environmental protection.
5. The proximity to North America and the ease of communication between inhabitants of that continent and those of the Caribbean have built up the expectations of the latter for a life-style similar to their more affluent neighbours.
6. Because of the year-round hot, tropical climate, pesticides are used continuously to maximise agricultural yields and to control vectors of human diseases.

A major problem arising out of the above factors is that of pollution of air, land and water. There is no doubt that the persistent Northeast Trade Winds tend to rapidly dilute and disperse emissions into the air. However, there is need to assess the effect that the impurities in the air have on the respiratory tract of humans in the cities where buildings are getting taller and streets are very narrow. These streets usually are very crowed with vehicles and pedestrians. There are also manufacturing establishments which use, as raw material, substances which are known to be harmful to man. In most such cases, protective mechanisms and clothing are provided as a matter of course. The difficulty lies in convincing the employees that such protection is necessary for their benefit and in convincing supervisors of their responsibility to their subordinates. Very often, when penalties are prescribed for non-compliance with safety precautions, such details are regarded by management as trivial.

Land and water pollution arise from various sources. It has been shown that in Trinidad there is inorganic mercury in the mangrove swamp at the mouth of the Caroni River, the largest natural watercourse in that Island. When one looks at the number of factories which discharge untreated effluent into that river and its many tributaries, there is reason to believe that investigation will reveal other heavy metals in its contaminants. The need for environmental standards for all effluents has fortunately been recognised by Trinidad and Tobago. The Institute of

Marine Affairs, an agency of the Government, is actively engaged in research which may result in the development of such standards to be included in Public Health or Environmental Legislation. This research is being done in collaboration with the Ministry of Health and Environment and hopefully will be applicable in other tropical environments. The need for Environmental Impact Assessments as part of the development process is well recognised in the sub-region. Several technical officers and professionals both in the Public and Private sector have been trained in the use of this tool. Most have received Government Scholarships or Fellowships from International Organisations. Courses are now being planned in several countries of the Caribbean so that trained personnel can pass their skills onto their colleagues under the guidance of expert consultants. However, development continues in the fields of industry, housing and the establishment of utilities without the incorporation of Environmental Impact Asessments in spite of the protests of officers trained to perform such assessments. The missing ingradient appears to be the lack of interest of the community whichis not yet prepared to participate in matters pertaining to environmental protection.

There is no dispute in the Caribbean that any public education programme must include programmes in schools at all levels. However, problems are being experienced in having environmental education included as a separate subject in the curricula of primary and secondary schools. It is claimed that it is impossible to include this as another subject because of the already overcrowded schedule. As a result, environmental topics are being incorporated into the established subjects, e.g. social studies and geography. One major drawback is that in teacher training, health education is still not given the prominence that is necessary for it to play a significant role in the classroom. In fact, in many cases health education is an optional subject for trainees and most of the time there is no examination at the end of this course. Traditionaly, health education, including Environmental Education in schools was, and still is, the task of members of health teams in the various districts of the islands. The education function of these teams is planned and guided by highly trained Health Educators who attempt to bridge the gap between Ministries of Health and Education. Whatever success Health Educators and their colleagues in the health teams have achieved in schools however, was not done without repeated frustration. In the not too distant past, these officers were regarded by school staff as intruders who persistently upset the smooth running of their schools. At present though, it is most heartening to note that at least in Trinidad and Tobago there is close cooperation between education and health officials, local Government representatives, members ofthe business community and others in the holding of a "Schools Environmental Sanitation" competition. This competition includes the physical condition of schools and their grounds over an extended period, debates, quizes, posters etc. In many islands Health Educators have successfully set up community groups which meet regularly to discuss their health services, including environmental health problems, set their priorities, make representations to relevant authorities and evaluate their success.

The media play an increasingly important role in Environmental Education in Caribbean countries. Most of the population owns radios and a large majority owns television sets. Radio stations, many of which are owned by Governments, exist in all territories, but these territories do not all transmit television programmes. It is relatively simple for residents of the latter to take advantage of the facilitis of their neighbours. Modern technology has added a new dimension to television viewing. It is now possible to obtain television programmes off the United States Satellites. While some islands reeive and retransmit live from the United States of America to varying extents, more affluent citizens can purchase the expensive facilities necessary for private reception. Many domestic radio and television stations have time allotted at prime time for "Government Programmes". Time is assigned to various Government agencis who wish to transmit messages to the public. Most of these programmes, however, are dull and unattractive and as a result, do not enjoy a large listening or viewing audience.

The most glaring problem which is common to all Caribbean Islands at the present time is the one of Solid Waste Management. The affluence of some countries, the proximity to North America and the need to cater for transient visitors have resulted in the increased use of non-biodegradable disposables. The absence of recycling technology has also resulted in excessive volumes of waste. The complacency of the majority of the population with respect to indiscriminate littering of public places like parks, roadsides, beaches etc., has been presenting immense problems to officials concerned with the disposal of waste. One Government in the sub-regiion, however, decided to face the problem of solid waste disposal with a view toward developing plans for an organised approach to solid waste management.

In 1979, the Government of Trinidad and Tobago awarded a contract to a joint venture company of foreign and local Engineering Consultants to study the existing state of solid waste management in that twin-island state and to make recommendations for its rationalization. This study brought to light the fact that equipment and techniques which were being used for waste collection and disposal were obsolete. It was also noted that no national guidelines existed resulting in the Local Government Authorities working in isolation and very often groping in the dark because of the lack of necessary expertise at local level.

From the various alternatives recommended to the Government in the final report entitled "Solid Waste Master Plan for Trinidad and Tobago", it was decided that a Company with limited liability will be formed with one shareholder, the Government. A Board of Directors was selected from among businessmen of the Private Sector and Officers of the Public Sector with relevant experience. Funds were allocated to the Company in accordance with the budget presented by the consultants in their study. The Trinidad and Tobago Solid Waste Management Company Limited came into existence in November, 1980. One of the recommendations of the "Master Plan" was the establishment within the Company, of a Public Relations Division, with a Public Relations Officer, a Secretary and two Public Relations Assistants. This Division became functional in April, 1981 with the appointment of a Public Education Manager. When it was decided by the Company that the most desirable approach to Solid Waste Management was through Public Education, it became obvious that the Public Relations Division, envisaged in the Master Plan was inadequate to perform the functions necessary. It was also found that eixsting facilities, both private and public, which were available for transmission of information to the public were expensive, of varying quality and hence, not dependable. The solution arrived at was the establishment of a "Media Division" of the Company with the capability to produce the audio visual aids, including a monthly newspaper which is widely circulated in Trinidad and Tobago. This newspaper is named "Charlie", a character developed by the Solid Waste Management Company Limited (Fig. 2).

Within one year of its existence, the Company made a significant impact on Solid Waste disposal, using the method of sanitary landfill. While this work was being done, however, a number of meetings and seminars were held with Government officials, people who generate large quantities of of waste and members of the public. It was soon found that the general public was willing to assist in the maintenance of a clean, healthy environment within their communities but, very often, their efforts were frustrated by lack of competent guidance and by unreliable services. The company tried to fill the void by organising the registration of "Neighbourhood Action Groiups" (NAG's) in communities, including schools and places of work. At present there are over 130 such groups throughout Trinidad and Tobago. Among these groups there is an annual competition. It may be noted that the 1985 competition is geared to make competitors aware of the need for a national approach to environmental cleanliness.

Like other member countries of the World Health Organization, the Caribbean islands are aiming at the goal of "Health for All by the year 2000". It is becoming increasingly obvious that the achievement of such a goal is dependent on sound environmental management since this must form an integral part of Primary Health Care.

ACKNOWLEDGEMENTS

I wish to acknowledge with thanks the Officers of the Staff of the Caribbean Programme Co-ordinator, PAHO/WHO, Barbados, for their kind assistance in discussing with me the educational approach to environmental problems in the Caribbean. The Officers of the Carribbean Conservation Association were also very helpful in disclosing the important role being played by the Association. Gratitude is also due to the Executive Chairman and staff of the Trinidad and Tobago Solid Waste Management Company Limited for their eagerness to provide information and audio-visual material for this presentation. Finally, I am grateful to the Committee on Science and Technology in Developing Countries for giving me the opportunity to highlight some of the problems of environmental management in the Caribbean and the efforts being made to solve them.

PERCEPTION AND ENVIRONMENTAL EDUCATION IN A HIGHLY COMPLEX SITUATION: THE ROME CASE STUDY

F. Amoni, M. Bonnes and M.V. Giuliani*

The present survey is part of an integrated programme of research on the city of Rome (1981) carried out within the framework of UNESCO-Man and Biosphere Project no. 11 on Urban Ecology Applied to the City of Rome with the help of specialists from different fields.

It is related in particular to the studies of the working group on "environmental perception" (Bonnes and Secchiaroli 1983, Bonnes 1984) involving different inhabitant age groups in an ecological approach for the purpose of gaining insight into the multiple dimensions linking both individuals and groups to this complex urban reality.

AIM

The primary aim of the survey involving a sample of young inhabitants reported herein is to serve as an integrated approach to the problem of environmental education. It has been assumed that an educational programme embracing specific environments can be developed more effectively within a plan of studies aimed at extending and integrating knowledge of both the physical and objective aspects of such environments and the perceptions and evaluations peculiar to the inhabitants.

The second aim is to develop a method for studying the perceptions and knowledge of a given category of inhabitants vis-a-vis a specific environment which could be used both in the preliminary survey and in a subsequent programme to monitor any changes in perception accompanying educational action.

The third aim is to use the above tools to design a focussed educational programme catering for the Rome urban environment, i.e., a programme whose contents will be chosen bearing in mind the specific nature of the environment and the characteristics of the perceptions and knowledge of the subjects of the educational programme itself.

The results reported herein refer to one of the early stages of research and specifically to the development and testing of a plan designed to analyse the subjects' knowledge of the environment and, even at this early stage, to detect inter-individual differences inthe way the environment is perceived and organized.

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METHOD

A questionnaire on the city of Rome was drawn up and administered to a sample of about 120 pupils of both sexes aged about 12 years, from different socio-economic backgrounds and attending three different Rome state secondary schools. The three schools were selected on the basis of their respective locations, i.e. the centre, the inner suburbs and the outer suburbs.

The responses to the questionnaire, which referred to three main urban areas, i.e. the centre, the residential area and the outer suburbs were quantitatively analysed using a multidimensional method designed to interpret both their form and content.

Both the descriptive (cognitive) and evaluative (affective) dimentions were taken into account with regard to the contents (Fig. 1). The descriptive content was characterized according to its mainly perceptive nature or to the extent to which it was an indicator of the above-mentioned environmental factors using Stokols' distinction (1981). The perceptive content was classified into two categories: town planning and architecture, and the meaning content into three categories: functional, environmental context, human context.

The evaluative content was defined according to whether the response given was positive, neutral or negative.

The following formal characteristics were taken into account:

Complexity, as a function of the number of categories, and

Clarity, as a function of the evidence concerning individual contents in the overall situation.

RESULTS

It lies outside our present scope to give a systematic account of all the results. We shall limit ourselves to illustrating a few comparative data referring to the answers given by the subjects to open questions eliciting a description of their own quarter and of the city centre for the main purpose of evaluating whether the same environmental referent implies a similar cognitive elaboration and at the same time, whether different environmental referents correspond to different cognitive elaborations.

One of the preliminary results refers to the influence of the subjects' socio-demographic and residential background on their environmental perception. In the case of all the constructs examined, there were found to be no significant differences related to the subject's sex and socio-economic level, while residential experience of different parts of the city was found to be an important differential factor

Content Dimensions

The overall results referring to the categories used by the subjects to describe their own quarter are set out in Fig. 2.

The continuous line refers to the city-centre school (A), the broken line to the intermediate-area school (B) and the dotted line to the outer suburbs school (C).

A trend shared by all observed representations is that the main attention is focused on the one hand on the architectural and/or town planning aspects, and on the other on the environmental context aspects. Less attention is paid to the human context aspects and very little to the functional aspects. The most significant differential factors (P= .001) came from the high incidence of architectural categories in the school A pupils' description, from the environmental context categories in that of the school B pupils and in the human relations context in that of the school C pupils.

As far as the description of the centre is concerned (Fig. 3), the cognitive representations of the three groups of subjects seem to be closer (P= n.s.). The trend furthest from the others was found to be that of the group of subjects from school C, i.e., the one furthest from the centre. The pupils from this school paid less attention to the spatial, functional and human context aspects of this city area, i.e. to aspects that may be assumed to be more closely linked to frequent environmental interactions. On the other hand, they were morre frequently struck by the architectural aspects (differences) and the environmental context aspects (especially the traffic) which were probably more immediate. The representations of the other two groups of subjects are closer, although the school A pupils paid more attention to the architectural aspects and those of school B to the functional aspects.

If the results of individual schools are examined in detail, in school A (Fig. 4) the cognitive representations of the quarter (continuous line) and the centre (broken line) are found to run fairly parallel (P= n.s.). A salient characteristic of the two descriptions is the predominance of the architectural and town planning categories vis-a-vis the others. The representational consistency displayed by this sample, which points to a uniform use being made of cognitive categories and can only partly be explained in terms of the fact that the residential quarter of the majority of subjects coincided with the area of the centre, has no equivalent in the other two groups.

The school B pupils (Fig. 5) give more highly differentiated descriptions (P= .05), mainly as a result of the lower significance of the architectural categories with respect to the quarter and of the environmental context categories vis-a-vis the centre. In fact, the latter are much enchanced with respect to the quarter. The most obvious points in common consist of the importance attached to the town planning aspects and the relative lack of importance of the human relations aspects found in both descriptions.

Finally. in the descriptions of the school C subjects (Fig. 6) each construct is characterized by a peculiar representation (P= .001) which, in case of the centre, refers emphatically to the architectural aspects, as well as to quarter, to the town planning, human relations and environmental context aspects.

The descriptions of the quarters given by the subjects of the three schools with reference to the specific contents of the representation referring to the three urban ares, i.e. to the most frequently used sub-categories, are shown in Fig. 7.

Examination of the contents most commonly used with reference to the perceptual categories in the descriptions of the pupils from schools A and B reveals the existence of a need to define one's own quarter vis-a-vis the city context in both spatial and stylistic terms (evident also in negative responses of the type "there are no monuments", "it's a quarter without a history", "tourists don't come here"). However, this tendency to contextualize one s own quarter of the city is apparently not displayed by the school C pupils and the absence of this anything but insignificant factor could point to a more fragmentary knowledge of the quarter as something detached from the rest of the city.

The school A pupils tend to characterize their quarter from the town planning standpoint mainly in terms of location and distance and, architecturlly speaking, as a function of the historical characteristics of the area and its subjective aesthetic appeal.

The school B pupils describe their quarter in town planning terms, i.e. from the standpoint of its peculiar features (e.g. the existence of parks) and from that of its location vis-a-vis the city. They define it architecturally on the basis of its modernity and its aesthetic attractiveness.

The school C pupils characterize their quarter in town planning terms as a function of the amount of parkland available. Architecturally speaking, they describe it in terms of aesthetic appeal and type of housing.

As far as significance categories are concerned, the three quarters are described rather differently from the standpoint of the environmental context. The most frequent references in school A are to the elitist/popular nature and the predominant joyful atmosphere: in school B the dirtiness or cleanliness and the stimulating/overstimulating nature; for school C dirtiness or cleanliness and the amount of motor traffic. All three groups share the same degree of attention paid to the quantitative, deviant and relational aspects of the human context, with additional references concerning the social composition of the quarter being proffered by the school A pupils.

It is interesting to see how the attention focused on the class characteristics of the quarter, present only to a limited extent in the other two categories, may reflect the peculiar upward transition of the socio-cultural composition of the resi-

Fig. 1. CONTENT DIMENSION

DESCRIPTIVE CONTENT
- PERCEPTIVE
  - TOWN PLANNING
  - ARCHITECTURE
- MEANING
  - FUNCTIONAL
  - ENVIRONMENTAL CONTEXT
  - HUMAN CONTEXT

EVALUATIVE CONTENT : POSITIVE – NEUTRAL – NEGATIVE

FORMAL DIMENSION

COMPLEXITY : HIGH – MEDIUM – LOW

(NUMBER OF CATEGORIES OF ENVIRONMENTAL FACTORS MAKING UP COGNITIVE REPRESENTATIONS)

CLARITY : HIGH – MEDIUM – LOW

(PREDOMINANCE OF A CATEGORIAL CONTENT VERSUS OTHER CONTENTS)

Fig. 2. CONTENT DIMENSION
DESCRIPTION OF THE RESIDENTIAL QUARTER

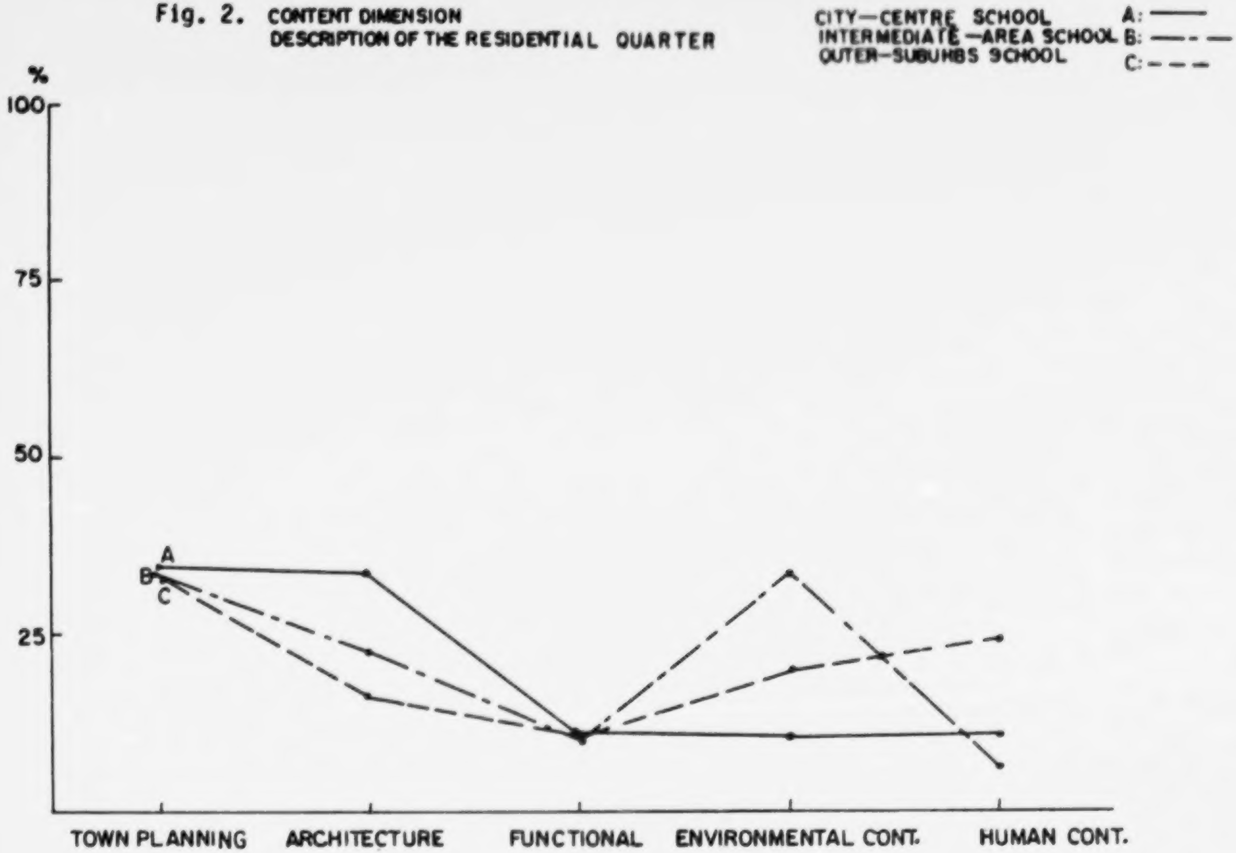
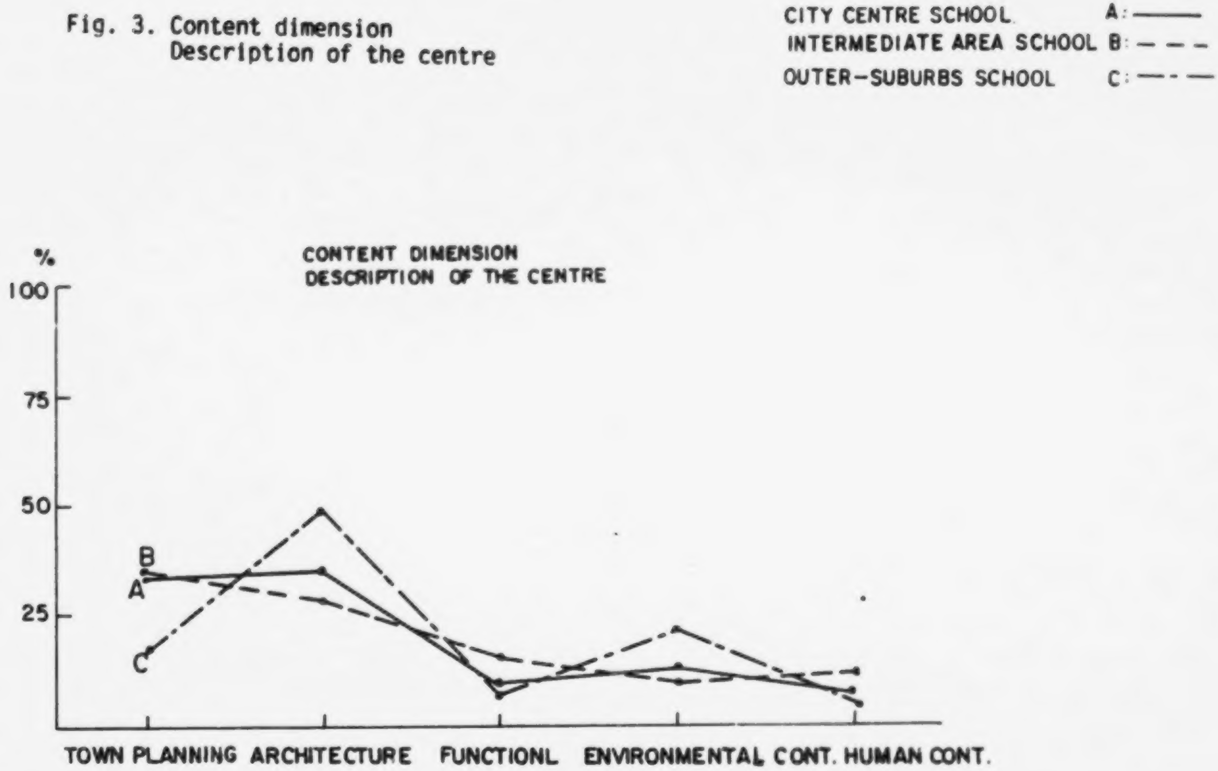


Fig. 3. Content dimension
Description of the centre



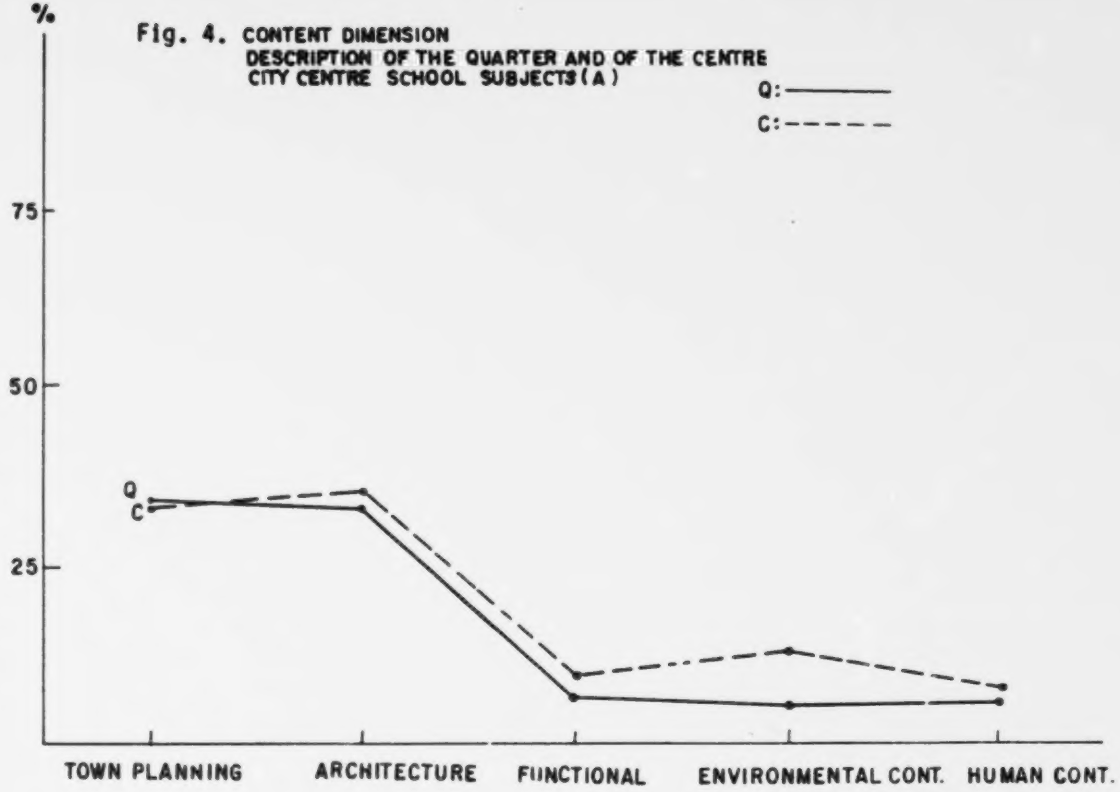


Fig. 4. CONTENT DIMENSION
DESCRIPTION OF THE QUARTER AND OF THE CENTRE
CITY CENTRE SCHOOL SUBJECTS (A)

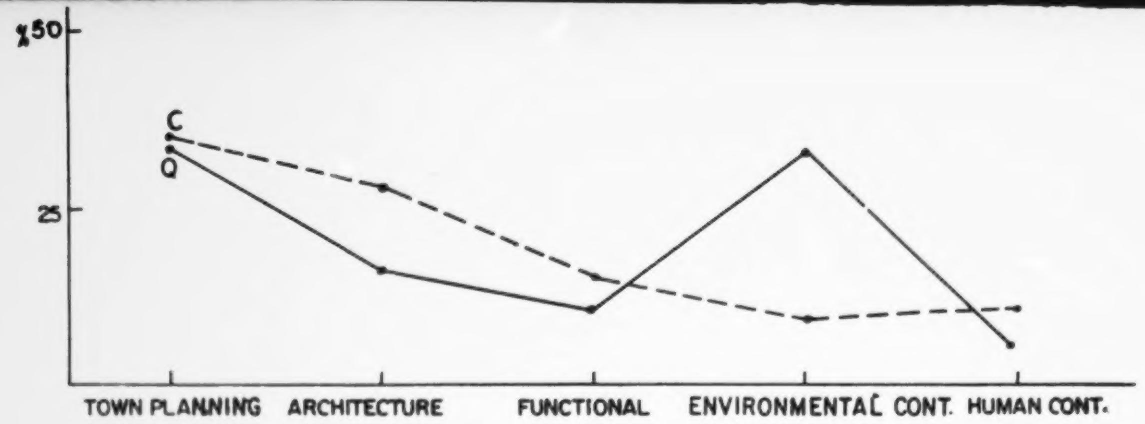


Fig. 5. Content dimension. Description of the quarter (Q) and the Centre (C)

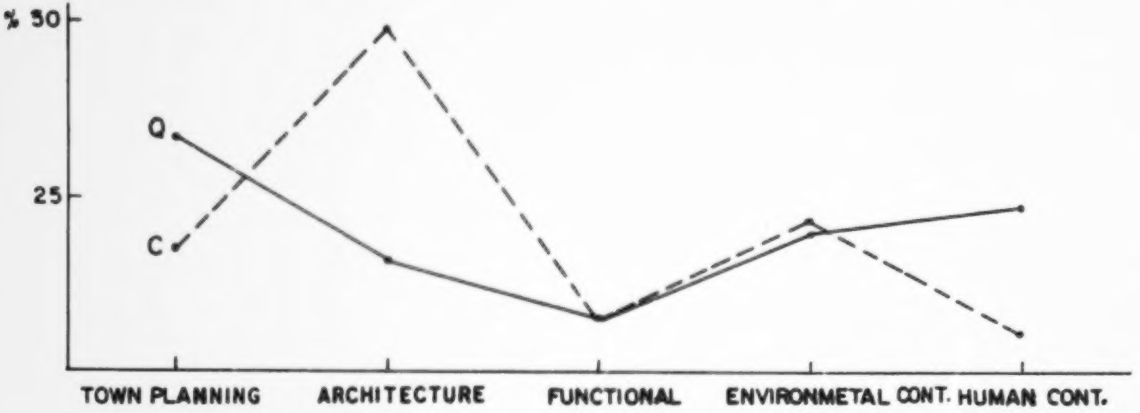


Fig. 6. Content dimension. Description of the quarter (Q) and the Centre-Outer suburbs school subjects (C)

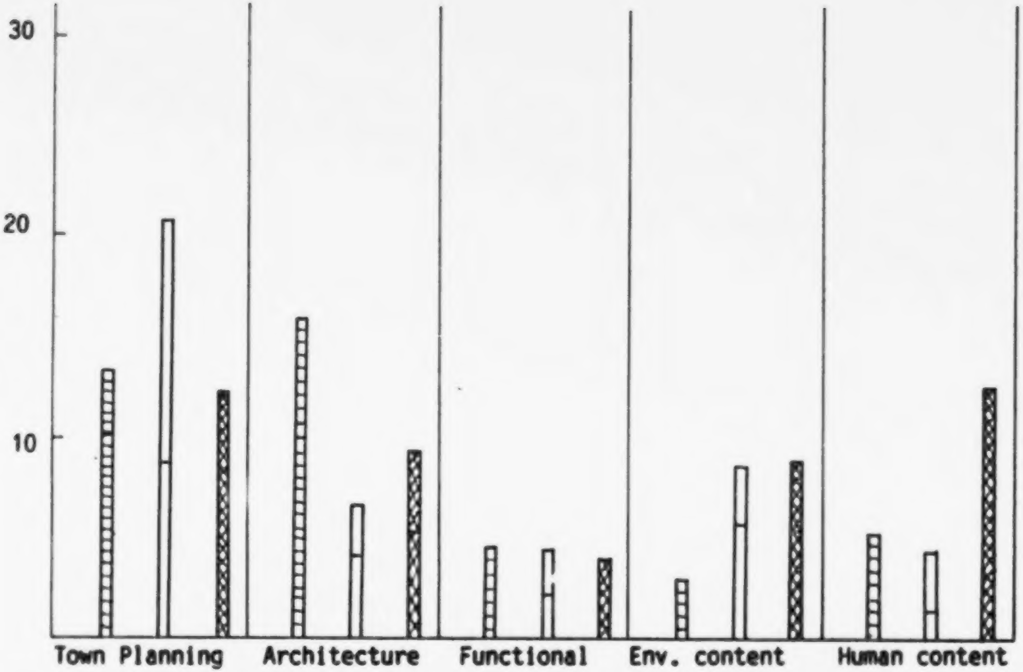


Fig. 7. Most frequently used categories in the description of the quarters

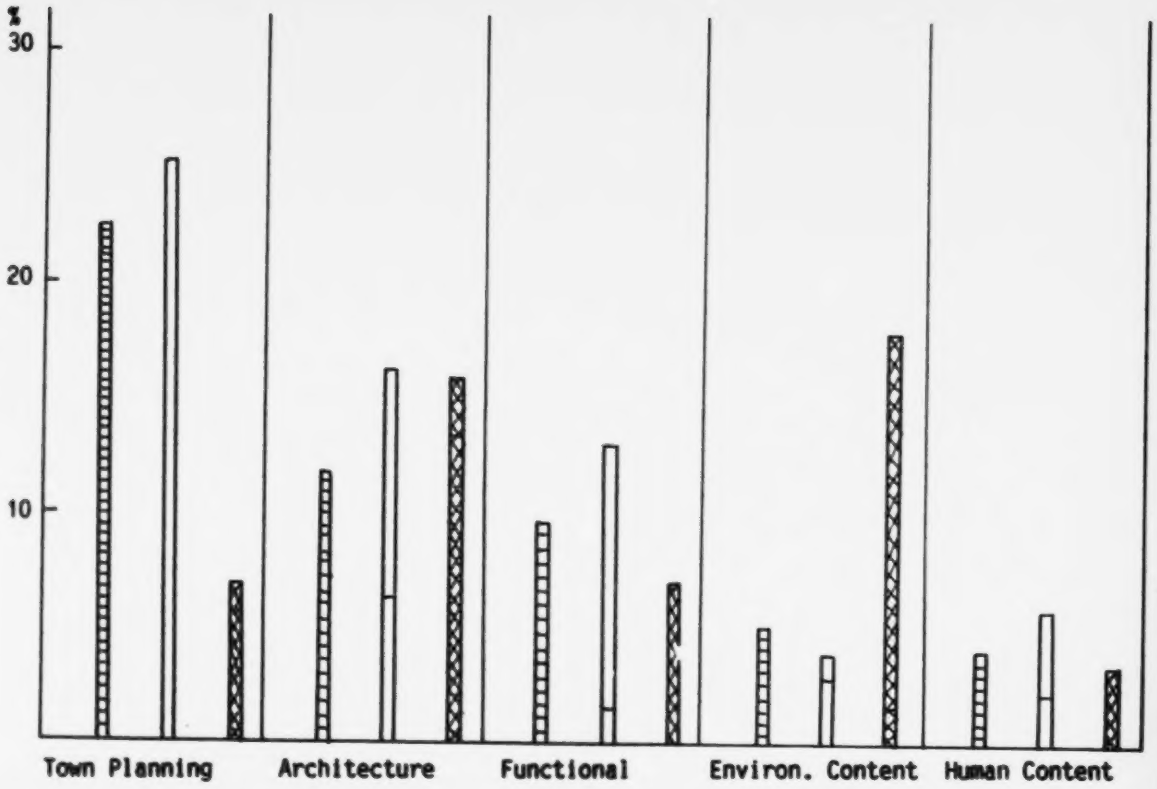


Fig. 8. Most frequently used subcategories in the description of the Centre

dential population of the historical centre of Rome.

The representations of the group of subjects from the centre tend to differ also with regard to the functional sub-categories more frequently used (e.g., the shopping functions, both generic and specific, easy communications, versus play facilities and general level of efficiency of the quarter, as indicated by the other two groups).

With respect to the quarter, the characteristics displayed in the representation of the centre seem to be more similar. As shown in Fig. 8, the sub-categories more frequently referred to in characterizing this area are constant factors in all three groups of subjects. Even though, as we have already seen in Fig. 3, the preferential reference to one or other of the broad thematic groups (e.g. town planning, architecture, etc.) is a variable apparently depending on the area of residence the contents of the subcategories of these references seems to be fairly constant and thus to reflect a comparatively stable and coherent image of the city's historical centre. This image is based upon the significance of the places, buildings and monuments, the bustle of the shopping area, the busy motor traffic is made appealing by its monuments and the liveliness and colour of the life going on there, but where life is made more difficult by the chaotic traffic and overcrowding and by the invasion of factors of human and environmental degradation.

Comparison of the aggregated data shows that the centre is described in a more highly polarized fashion, with the accent on highly characterizing elements in the form of specific places and buildings. In the case of the perception of the quarter, greater importance seems to attach to remarks both positive and negative, concerning the more directly interactive aspects, e.g. the human relations context availability of park areas and play facilities, cleanliness and in general anything more directly connected with actual living conditions.

Among the overall opinions expressed the following are worth stressing, particularly for the purpose of an environmental education programme: the need for parks and green spaces, the capacity to appreciate historical and artistic values, the sensitivity to all the factors of environmental context more directly related to inhabitability and the quality of life, and, lastly, the intrusion into young people's everyday life of problems associated with deviance, drugs and violence.

Formal Dimensions

Examination of the formal assects of the cognitive representations of the centre and of the quarters, respectively, has revealed the existence of different patterns of category content.

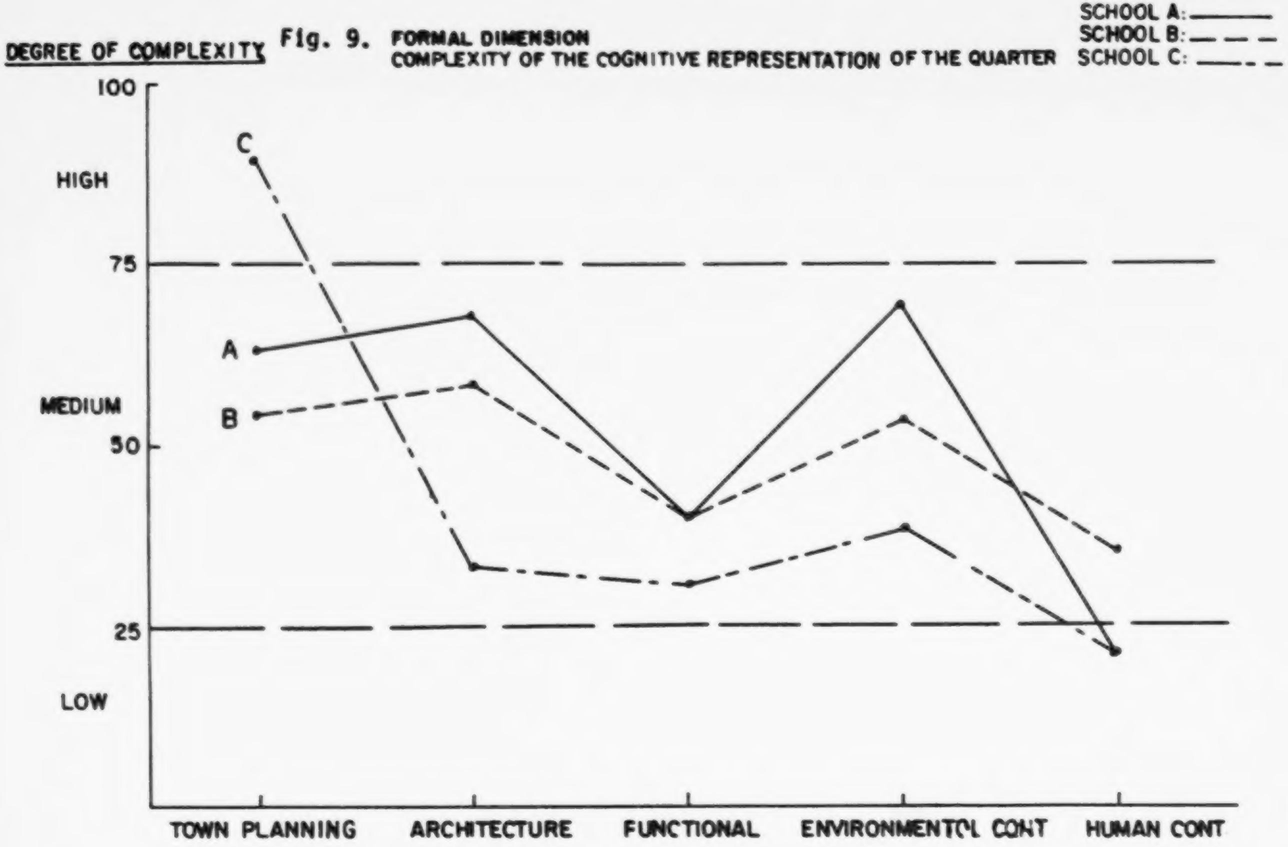


Fig. 9. FORMAL DIMENSION
COMPLEXITY OF THE COGNITIVE REPRESENTATION OF THE QUARTER

Fig. 10. FORMAL DIMENSION
COMPLEXITY OF THE COGNITIVE REPRESENTATION OF THE CENTRE

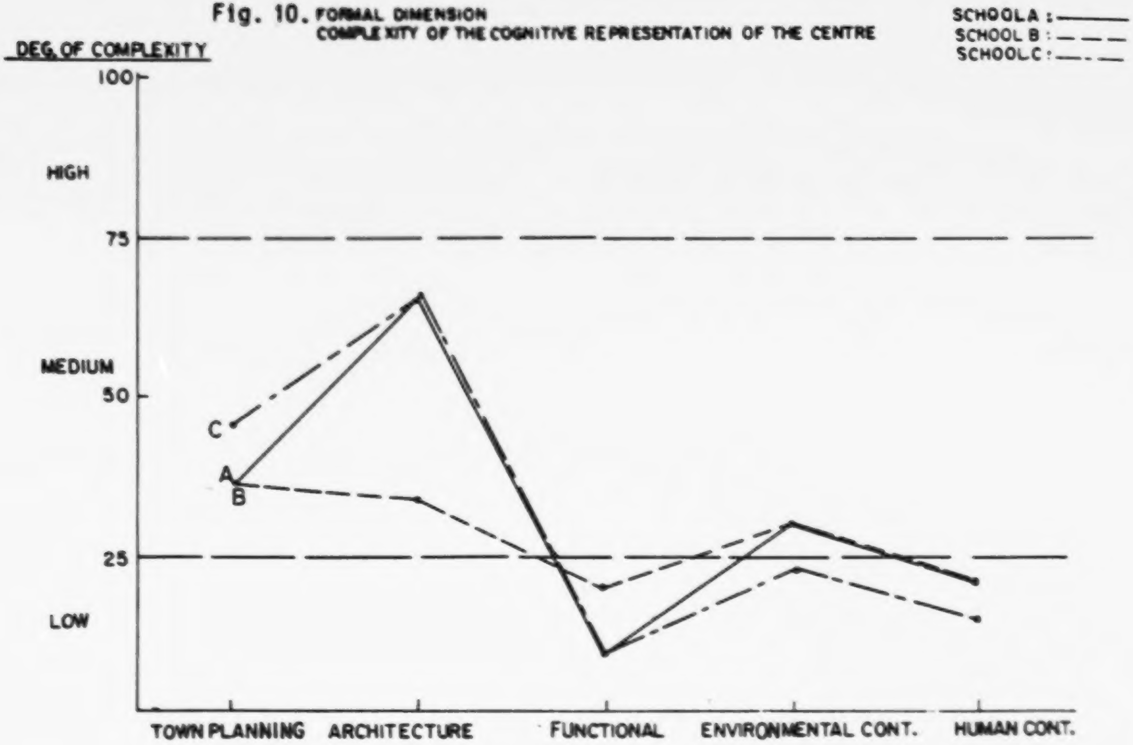
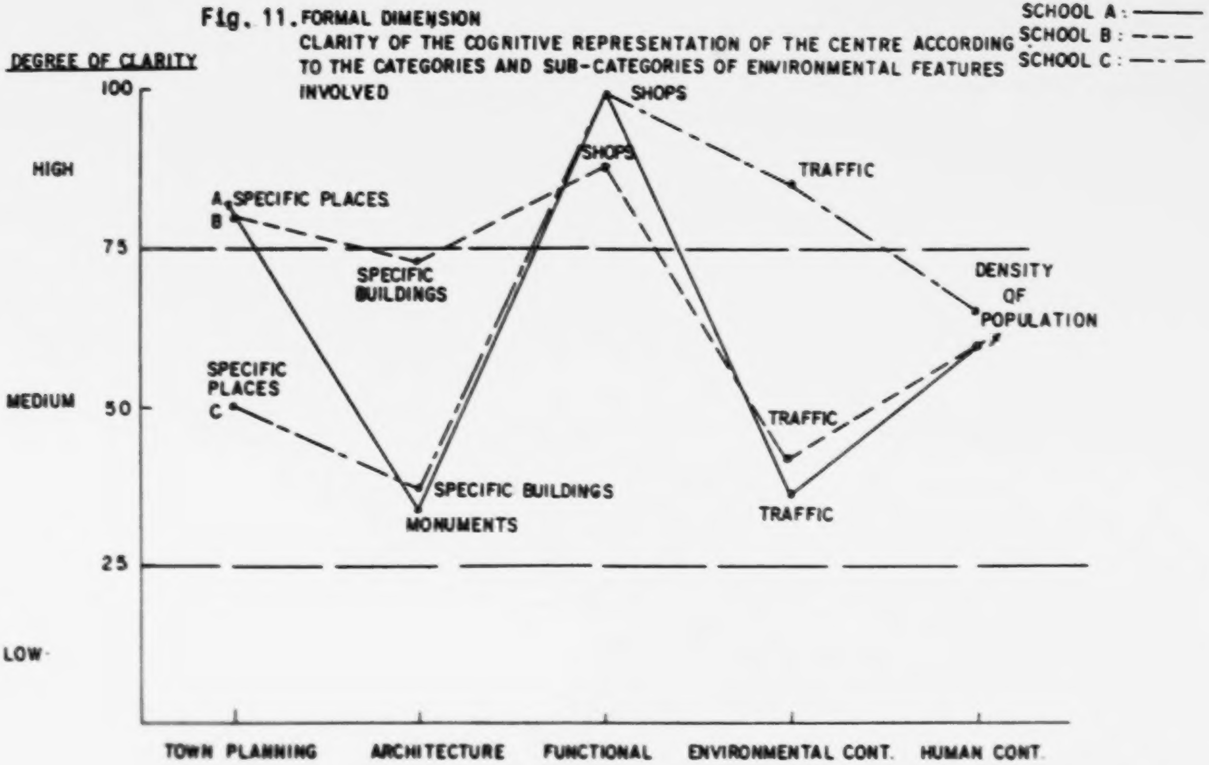


Fig. 11. FORMAL DIMENSION
CLARITY OF THE COGNITIVE REPRESENTATION OF THE CENTRE ACCORDING TO THE CATEGORIES AND SUB-CATEGORIES OF ENVIRONMENTAL FEATURES INVOLVED



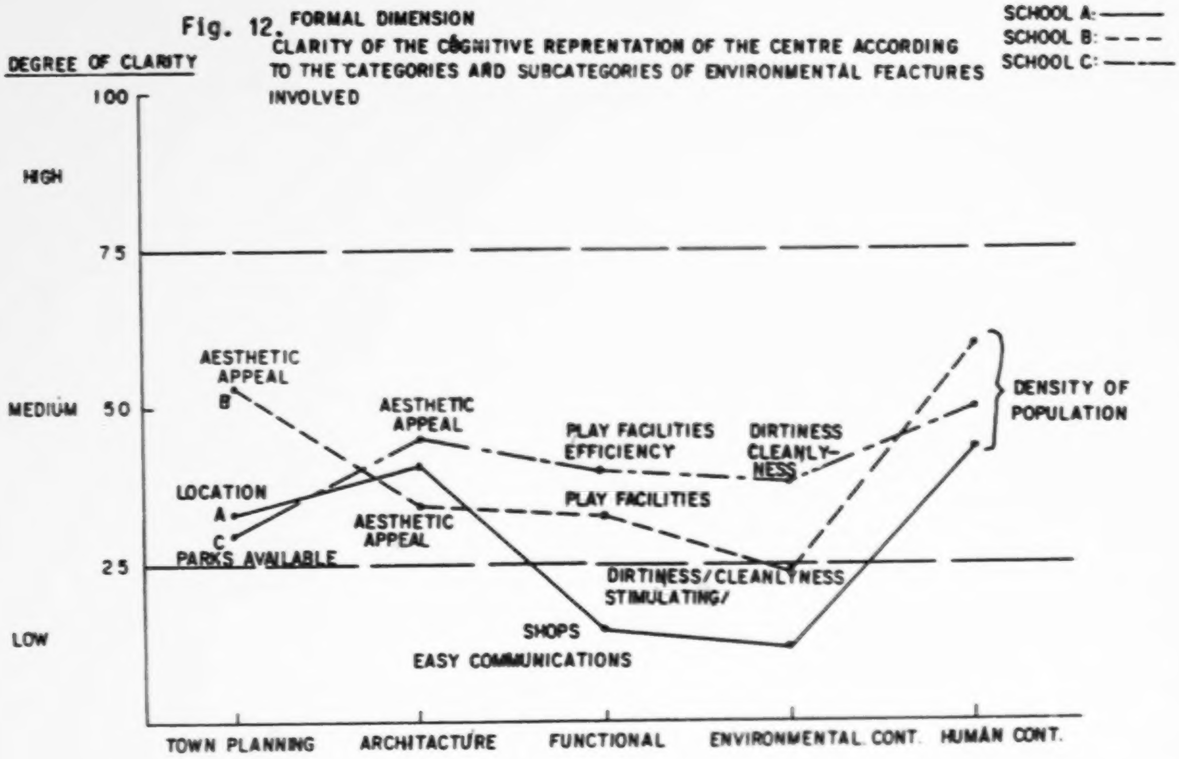


Fig. 12. FORMAL DIMENSION
CLARITY OF THE COGNITIVE REPRENTATION OF THE CENTRE ACCORDING TO THE CATEGORIES AND SUBCATEGORIES OF ENVIRONMENTAL FEACTURES INVOLVED

Complexity

Generally speaking, as in case of the analysis of response content, the graphic representations display a trend characterized by two peaks corresponding to the town planning and/or architectural aspects, on the one hand, and to the environmental context, on the other. The complexity of the opinions held on certain aspects of the city is directly proportional to the degree of interest aroused by these aspects. Therefore, the more often a category is used in the description, the more often sub-categories of it and associated shades of meaning are specified.

The representations of the quarter given by the three groups of subjects from the standpoint of complexity are shown in Fig. 10. The three constructs are seen to be quite clearly differentiated (P= .001), schools A and B with comparatively similar patterns, and school C a quite different one.

In the representations of the school in the town centre and of that in the inner suburbs there is a tendency towards stressing both the architectural and the environmental aspects, the latter are more emphasized in the intermediate school and the former in the central school. The highest absolute degree of complexity occurred in the use of the town planning categories in the description of the outer suburbs school, in which 80% of the sub-categories were used. Furthermore this corresponds to a lower degree of complexity in the use of the other categories than in the other schools.

The description of the centre (Fig. 10) reveals an average complexity for all three schools that is lower than that of the quarter. The greater complexity of the quarter is thus probably related to the greater degree of familiarity, i.e. of knowledge and interactions, allowed by such an environment.

Comparison of the three groups' knowledge revealed somewhat different trends also in this case (P= .01), although to a lesser extent than for the quarter. The curves furthest apart seem to be those ofschools B and C, while school A displays a tendency to share aspects first with one and then with the other. In particular, it approaches school C in that it reaches peak complexity with reference to the sub-categories used in the description in architectural terms, and the lowest point withreference to the functional categories, while it resembles school B as far the town planning categories, those of environmental context and of the human context are concerned.

Clarity

The dimension of clarity (i.e. the predominance, in terms of frequency, of one sub-category versus another) tends towards the opposite direction tocomplexity and is related to the high degree of attraction exerted by certain sub-categorical contents with reference to specific urban contexts. As a rule clarity is inversely proportional to familiarity, i.e. to the degree of knowledge of and interaction with an environment. It thus appears to be related to the greater stereotype inthe direction of both simplification and symbolization resulting from smaller knowledge.

Comparison of the data referring to clarity shows that on the average this notion reaches a much higher level in the centre than in the outer suburbs.

Furthermore, Fig. 11, which sets out the descriptions of the centre also shows how a considerable differentiation of the levels of clarity referring to the large groups of categories (P= .001) corresponds to a unanimous identification of the more significant sub-categorical contents (e.g. specific places, specific buildings (monuments for school A), shops, traffic, and number of people).

As far as the quarter is concerned (Fig. 12), the trends in the clarity levels of the three descriptions do not appear to differ appreciably (P= n.s.) while the specific sub-categorical contents seem to identify two different notions of the quarter, on the one hand, that of residents of the historical centre, and on the other that of residents in the two modern areas.

The pupils from school A describe their own quarter situated in the historical centre of the city, in terms of location, history, existence of shops and communication facilities, elitist/popular nature and observation concerning the atmosphere, mostly described using the terms of 'lively' and 'animated'.

The descriptions of the pupils in the other two schools, one situated in an intermediate area with large available green spaces, and the other in the outer suburbs, share the same themes: parks, degree of aesthetic appreciation, play facilities, degree of cleanliness or dirtiness of the quarter.

Finally, all three groups of subjects share a high degree of clarity with reference to the human context, unanimously referred to the density of population.

CONCLUSION

The overall results obtained so far indicate that the method developed and used to study urban environmental cognition is satisfactory and capable of revealing differences in individual perceptions, knowledge pertaining to the urban environment and parts thereof.

This tool could thus be used to study any modifications in these perceptions while specific environmental education programmes were being run.

Secondly, the fact that the "basic" environmental knowledge regarding complexity, clarity and contents of the young people participating in the survey was largely dependent on the type of specific residential experience they had had, seems to point to the advisability of taking as much account as possible of the specific nature of the context closest to the subjects in order to bring them towards a truly ecological understanding of the urban environment based on their direct environmental knowledge and needs.

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MAKING ENVIRONMENTAL EDUCATION RELEVANT IN INDIA

A.B. Saxena

THE QUESTION OF RELEVANCE

An examination of environmental education (EE) programmes (Lucas 1980 Unesco 1981 saxena 1984) shows that they emphasized 'process" education and also the education of "attitudes" and "values". The development of a process is mainly confined to skills or problem solving which is value free and hence non-controversial. Morevover, the skills are content independent in the sense that they provide the necessary tool which can be applied to solve any problm may it be in developing or developed country The same is not the case with attitudes and values They have roots in social, economic and cultural context of the environment. Hence treating them in the classroom is difficult. Unless issues are analysed dispassionately in terms of cause effect and implications, it is difficult to reach the root cause of the problem. Stapp (1978) has provided a good working procedure to do this and it is illustrated in Fig. 1. The analysis starts with a major environmental issue and studies it in terms of major reasons for environmental abuses. These can be due to individual behaviour patterns such as increasing litter or governmental behaviour patterns such as unstrategic nuclear waste disposal. The problem can further be studied in terms of actions to reduce behaviour responsible for the problem. Finally it boils down to the objective of environmental eduction in terms of attitudes, value formation and skill development. However, the causes of environmental crisis in different countries may be due to poverty, increasing population etc., whereas in the developed countries the crisis may be due to affluence. Because of different socio economic background the crises which countries face are different. For example, in some countries the population is increasing fast This is more so in developing countries as rate of increasing population and affluence are inversely linked. In some developed countries such as Germany the population is decreasing and may cause alarm. However, there are also some environmental problems common to both developed and developing countries. Some such problems are decreasing forest area, air pollution, water pollution etc., though it is recognised that the cause of such problems may be rooted in the context of the country itself.

This brings us to the question of relevant environmental education. Unfortunately, due to many reasons such as "fixed curriculum, standard examination over a vast region children often study environment such as "tundra", "tropical forests", "deserts", which may be very remote to them with hardly any likelihood of encountering these environments. On the contrary the environments which are nearer often go unnoticed and unstudied. No doubt studying the remote environment may be useful to some extent but priorities seem to be lopsided.

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Children should do field work in the nearby environment, collect data about the problems related to their socio economic environment. In this context the environment becomes the laboratory with the aim that children can observe the ongoing forces and draw their own conclusions. Perhaps it may not be advantageous for the children to study many environment superficially rather than to study few, may be one, environment thoroughly. This will make them to understand the underlying currents in the environment and see relationships between different components. Once equipped with methodology and skills for doing so they will find it easy to study and analyze other environment as and when need be.

This would imply that (Vivian 1973)

* Children will frequently leave the class room to study various environments first hand.
* The school and the community will have to communicate with each other about environmental problems and decisions.
* The school and community will interact for planning of the improvement of environmental quality.
* They will execute some of those plans together.

Stapp (1978) has provided some guiding principles to help achieve these. The principles are;

"Environmental education should;

Consider the environment in its totality - natural and built ecological political economic technological social legislative cultural and aesthetic.

Be a continuous life long process, it should begin at the pre-school level and continue through all formal and nonformal stages.

Be interdisciplinary in its approach, drawing on the specific content of each discipline in making possible a holistic and balanced perspective.

Emphasized active participation in preventing environmental problems and working towards their solution.

Enable learners to play a role in planning their learning experiences and provide an opportunity for making decisions and accepting their consequences.

Focus on current and potential environmental situations.

Explicitly consider environmental aspects in plans for development and growth.

Promote inter-relationship of people and environment.

Examine environmental issues from local national and international points of view so that learners receive insight into environmental conditions in other geographical areas.

Focus on the learner s own community and relating topics being discussed to state regional national and international issues and perspectives.

Relating environmental sensitivity knowledge problem solving and vlaues at very grade level but with special emphasis on environmental sensitivity in early years.

Emphasise the complexity of environmental problems and the need to develop critical thinking and problem solving skills.

Utilize diverse learning environment and a broad array of educational approaches to teaching/learning about and from the environment with due stress on practical activities and first hand experiences".

THE RELEVANCE INTO PRACTICE

The considerations discussed so far show that only interdisciplinary tasks are suitable for EE program However it is difficult to see what areas are to be covered and what methods may be used. Perhaps the choice of the topic is very important and will depend on social, economic and cultural background which are important in discussing the issue. A topic like "population" may be more relevant in developing country where population is increasing at an alarming rate rather than in a country where population increase is not in the background of the children. Therefore , the choice of the topic is important and must be made with care.

The treattment of the topic and the literature consultation forms another important aspect of relevance One has to see what are the different relevant aspects of the topic and how far these are being covered. Many times irrelevant juxtapositions may be confusing and/or misleading. The observation that "There are many educational films which adopt a racist and apocalyptic attitude, linking the so called population explosion' of the Third World with environmental pollution. so that the spectator is lead to believe that an environmental explosion is occurring as a result of demographic pollution by coloured people. this belief leads to acceptance of wars in the Third World natural 'accident' such as famine and disease or the withholding of medical assistance as the solution of the problems" (Caiappo 1978) shows how important it is to see the problem in the right context and also that the choice of the literature is very important for films are no exception to this kind of remark. Other educational material can also be found with similar bearing.

The philosophy of such a relevant EE is depicted in Fig. 2.

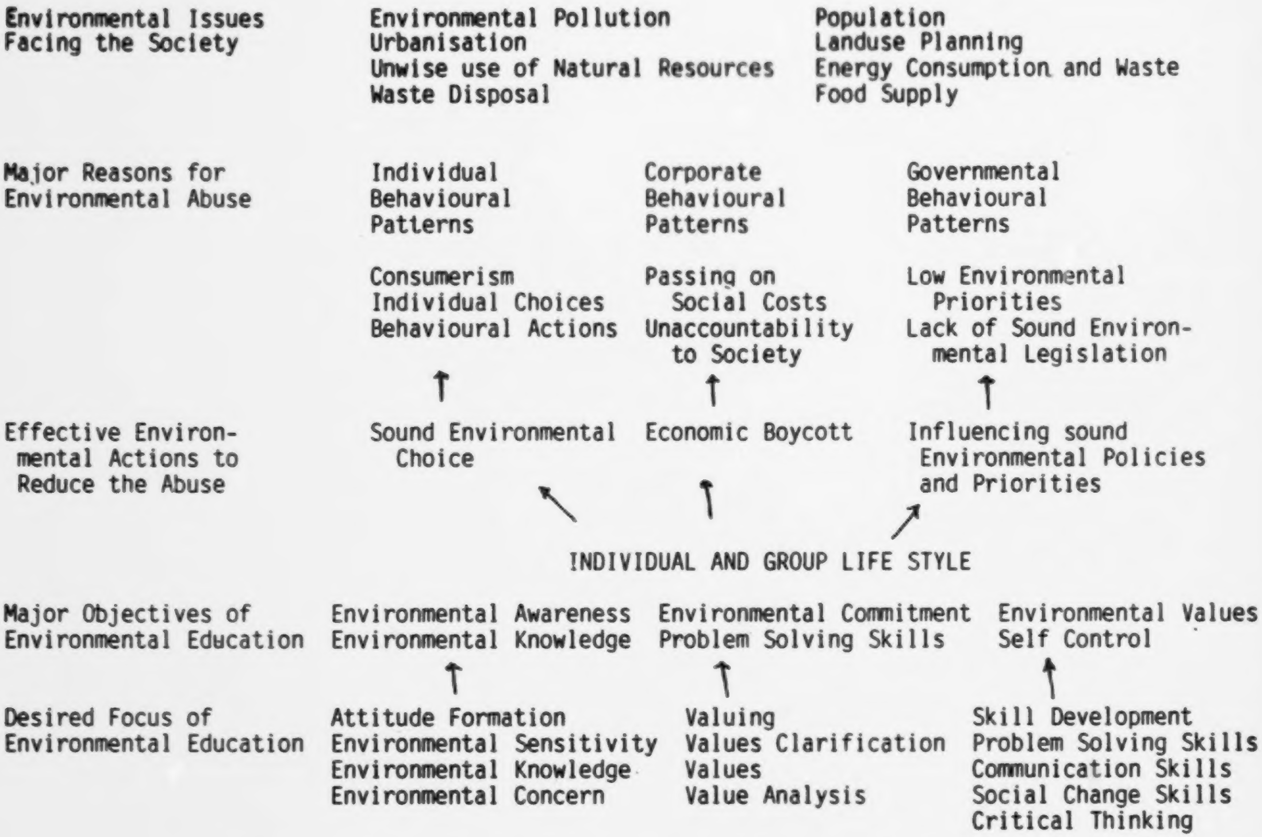
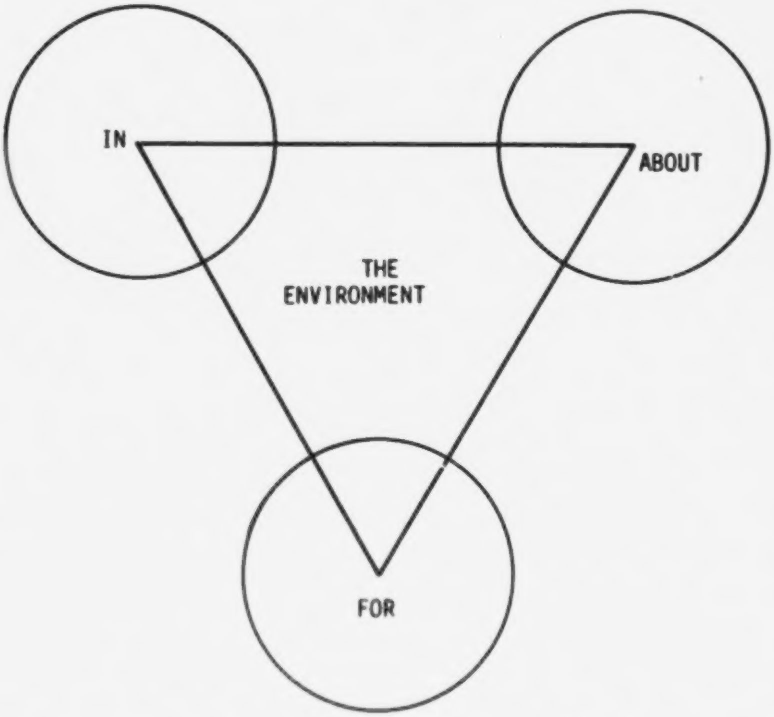

Environmental Issues Facing the Society
Environmental Pollution
Urbanisation
Unwise use of Natural Resources
Waste Disposal
Population
Landuse Planning
Energy Consumption and Waste
Food Supply
Major Reasons for Environmental Abuse
Individual Behavioural Patterns
Corporate Behavioural Patterns
Governmental Behavioural Patterns
Consumerism
Individual Choices
Behavioural Actions
Passing on Social Costs
Unaccountability to Society
Low Environmental Priorities
Lack of Sound Environmental Legislation
Effective Environmental Actions to Reduce the Abuse
Sound Environmental Choice
Economic Boycott
Influencing sound Environmental Policies and Priorities
INDIVIDUAL AND GROUP LIFE STYLE
Major Objectives of Environmental Education
Environmental Awareness
Environmental Knowledge
Environmental Commitment
Problem Solving Skills
Environmental Values
Self Control
Desired Focus of Environmental Education
Attitude Formation
Environmental Sensitivity
Environmental Knowledge
Environmental Concern
Valuing
Values Clarification
Values
Value Analysis
Skill Development
Problem Solving Skills
Communication Skills
Social Change Skills
Critical Thinking

Fig. 1. Symptoms versus root causes of environmental crisis



Using environment as resource for developing enquiry skills

Finding out about a particular environment and about environmental topics and issues

Building educational activities aimed at developing positive values based on informed consideration, care and concern

Fig. 2. The relevant environmental education

For the purpose of planning the study the following questions may have important bearing;
- What are important objects or events relevant for the study?
- How the objects/events are related to the environment and/or to the objectives of the study?
- What kind of records can be made and data collected?
- How the records are to be analysed to reach some kind of objective interpretations
- What are the implications of the result in terms of social-individual corporate and govermental behaviour?
- How the desired behaviour can be achieved?

Despite the emphasis on interdisciplinary approach in literature the fact is that most of the school programmes still tend to accentuate the individual subjects. Very few programmes do really integrate the environment in the curricula, pay attention to experimentation and the need of the children all necessary ingradients for relevant EE programme. For this to achieve one would need to adapt the content and methods of education more closely and also the more flexibility for the natural, cultural and human environment in which education is provided. In the developing countries the effect of the inherited colonial system is still large and needs modification according to the local requirements (Unesco 1982).

What is needed is the appropriate mixture of awareness programme, exposure to real life, conservation and developmental programmes. Fig. 3 provides a rough idea of relative percentage of these different kinds of EE programmes that are needed at primary, lower secondary, tertiary and adult education levels. At primary level environmental awareness is most important whereas development is of little use. As one goes to higher stages of education, environmental awareness becomes less important and other components gain increasing importance. Finally at tertiary and adult education level, development is most important aspect of EE. Obviously this distribution cannot be final and will also depend on the philosophy of programmes and other considerations.

Another way of looking at different aspects of EE, i.e. environmental sensitivity, factual knwowledge, problem solving skill, and planet earth philosophy with varying emphasis, can be shown as in Fig. 4. It shows that factual knowledge which is closely related to environmental awareness is very important in the early years of education. But in this depiction planet earth philosophy and problem solving skills are also important in early years of education. Their importance decrease with increase in years of education. The difficulty with this kind of emphasis is that it stresses too much on problem solving skills and it is doubtful that this is practicable, especially when it is rare to see real problem solving and scientific methods being used in the classroom. Most of the time children are able to 'know' the

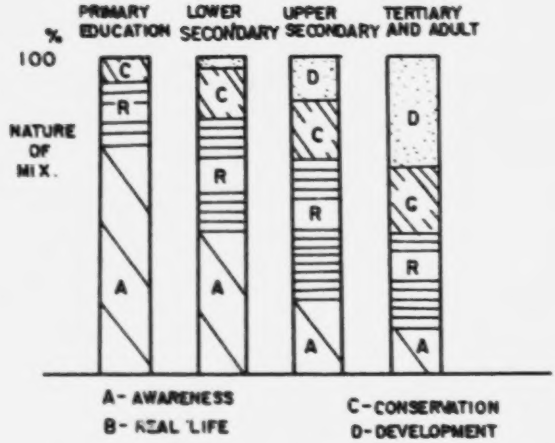


Fig. 3. Appropriate type (%) of EE suitable for different stages of education

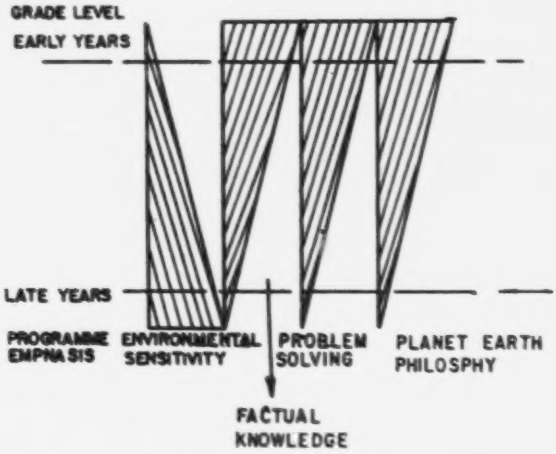

GRADE LEVEL
EARLY YEARS
LATE YEARS
PROGRAMME EMPHASIS
ENVIRONMENTAL SENSITIVITY
PROBLEM SOLVING
PLANET EARTH PHILOSPHY
FACTUAL KNOWLEDGE

Fig. 4. Areas of emphasis for EE Programme

right" answer and try to get it. The exercise of solving a problem looks more like a way of reaching predetermined answer.

NEW DIMENSIONS OF RELEVANCE

Environmental Education for Handicapped Children

Lines and Bolwell (1971) suggest the use of environmental studies for children with learning difficulties. Conceding the fact that such children cannot do such an elaborate study as the normal children, nor over a very long duration of time, they argue that The advantages of this approach are that it is sufficiently flexible for children of different ability levels and differing degrees of physical handicap to contribute individually to class or group work, and group work enables them to develop their language and other basic skills. It is also argued that for the development of reading skills, it is necessary to develop skills of oral communication and adequate vocabulary. These can be improved upon to a considerable extent by encouraging the children to talk about their local environment and experience with it.

Out of School Education

Out of School education comprises of all the activities undertaken outside the formal curriculum and teaching period. These activities may comprise of informal activities such as camps, trails etc. The important point about these activities is that these are mostly pursued by the children becuase of their interest in these without much help from teacher of formal school system. It is different from informal education and non-formal education both of which take place as a result of factors external to school system. Atputnanathan (1982) describes the salient features of residential camps as following:

1. The participants are there of their own free choice and sometimes when there is greater demand additional camps are held for a selection is made of the most interested participants. This is done by means of questionnaire and recommendations.
2. The programmes are mainly for life- and development-oriented projects Sometimes one component may overlap the other. It is also possible that a series of camps has to be held to focus attention on a project.

Such out of School activities can be very useful for EE because children are self motivated and these do not overburden the school curriculum. Many a time the activities to be taken up are also decided by the children and objectives are set.

Emphasis on Local Resources

Another dimension of EE is with the emphasis on using low-cost/non cost environmental aids that can be used for conducting scientific activities. This is additional dimension (Rajput et al. 1980) apart from developing positive attitude towards environment and increasing environmental awareness. The philosophy behind this approach is simple and stright forward. In the developing countries, the resources are meagre and if eduction has to flourish, it should require minimum resources Whatsover resources it needs must come as far as possible from the environment including the community. It is difficult for an educational programme to succeed in the long run if this is heavily dependent on the resources from outside.

CONSTRAINTS IN MAKING EE RELEVANT

Resource Constraints

Lack of resources is considered as a major constraint in implementing EE programmes. In developing countries it is really a handicap to work with minimal resources. Any EE programme requires to succeed at least minimum resources, both in terms of money and trained personnel. Secondly in developing countries the pupil-teacher ratio is large making it difficult for the teacher to adopt investigative and experimentation approach. Finally due to high drop-out rate at primary level, it is necessary to emphasize it at this level in order to reach the largest cross section of the society.

This leads to the infusion method of incorporating EE within the school curiculum. Infusion does not impose an additional burden of personnel or equipment The approach based on available local resources in the school and/or community has the additonal advantage of not requiring extra finance. This kind of approach may be slow to spread, less attractive at the first glance but more likely to succeed than the one which demands from outside monetary support. teaching aids and training of the personnel. In this new approach the overhead projector may be replaced by simple coloured diagrams, video-film by role playing or dramatization and other sophisticated equipments by simple innovative devices and so on.

Social Constraints

Inclusion of environmental issues based learning is useful no doubt. but many a times the conclusions of the study may come in direct conflict with social, religious or political thinking. This may lead to conflict and in some cases to confrontation. Environmental action is an important part of EE without which it becomes meaningless. Its incorporation is full of difficulties.

Constraints Related to School

The other constraints stem from the tentative and uncertain final nature ofthe solution to the problem It requires a teacher to move from the area of definitive answer to many probable with none of them as final solution. Teachers that are not trained and accustomed for this kind of situation may feel his/her position threatened. Problems may also arrive from parents who may not feel EE as enough academic, or from politcians feeling that such an approach is too political (Knamiller 1983).

Assessment of work done under EE projects is difficult and time consuming Many times it is difficult to think of a common yardstick to evaluate the work done under projects of different nature. In such cases, the assessment may be subjective and the teacher needs to become skilled at observing children's activities and at their evaluation. In some countries EE is not the part of the formal examination system. Willingness to experiment with innovative methods is often damped by the fact that the children are mostly evaluated on the basis of factual knowledge.

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COMMUNICATION STRATEGY FOR ENVIRONMENTAL EDUCATION

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It is only over the last decade that an awareness of environmental issues has been created amongst a cross section of the population. It is unfortunate that such awareness has come as a result of a growing environmental crisis. In the West the crisis manifests itself in the form of pollution and other effects of industrialization. In developing countries where industrialization is yet in its infancy, there is a far wider range of environmental issues. Wood is still the primary source of energy in many of these economies Conflicts between man and animal and man and forests are much sharper and much more direct. Programmes for preserving genetic diversity are not an abstract academic issue here, but a question of making hard developmental choices betwen projects to build dams and plans to preserve forests. While in the West the focus of the environmental movement is on control. in the developing countries it is as much on planning. To this extent, the thrust of environmental education needs to be on bringing to surface linkages between environment and development and to find ways of integrating environmental considerations in development planning.

Environmental groups in the developed countries have had to take an anti-establishment, anti-goverment stand for they have to argue against existing lobbies and powerful interest groups. Faced with the terrible environmental degradation thathas already taken place through rapid industrialization and urban growth the environmental movement in the West is now trying to stop further destruction and improve the situation. In the developing countries where there is still so much to preserve, there is scope to plan development strategies in a way that they can best use natural resources rather than plunder them and leave nothing for the generations to come.

Awareness of these issues is required at several levels, at primary and even kindergarten levels, in high schools, colleges and universities and mainly among the general community. Environmental education needs to reach specific target groups in both urban and rural areas. The issues cover a wide variety of topics from cleaning rivers to preserving forests to having open spaces for the urban areas to using innovative technologies that are environmentally sound. The target groups for such communication are equally varied. Environment is not a sector of our society or a separate compartment of our lives but concerns just about all aspects of our existence. Environmental education, therefore, cannot be looked upon in isolation but has to integrate with networks in the country which are already in the field of dissemination of knowledge of creating public awareness or of undertaking development projects. But in order to effectively interact with this network and to ensure that it responds to the challenges of environment education, a well planned and creative strategy needs to be adopted. There is a need for generating new environment education programmes and material and for training personnel to use these. There is a need to create demonstration areas and show examples of programmes which can be trend setting to the rest of the country.

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In India, as in fact in many countries, the field of environment and along with it environment education tends to be looked at as a separate discipline. Environment education efforts have thus tried to establish new independent communications directly with the end beneficiaries or target groups rather than integrating their efforts with existing communication networks. Such efforts through organizing societies, clubs, lectures, film shows and printing posters and other publicty material is very useful but can only have a limited impact on the mainstream of society. An attempt has to be made to integrate environmental education with the larger educational and development programmes of the country.

Realizing the tremendous task and the need to develop innovative programmes and materials in the field of environmental education the Department of Environment Government of India has set up the Centre for Environment Education at Ahmedabad Following a tradition of building scientific institutions around a good group that would act as a nucleus, the Department of Environment has established this Centre using the people and programmes of VIKSAT and other institutions of Nehru Foundation for Development as its core. I would like to use examples of some programmes of this Centre to describe a communication strategy that is built sound institutional collaboration in the field of environment education. In each case we describe the linkages with relevant networks that are required for the success of the pogramme.

A very obvious linkage in this case is with the schools, colleges and universities There are in this country boards of primary and secondary education at the State level which set the curriculum There are textbook boards which oversee and prepare all the book material which goes into the schools. There are a number of private agencies which prepare other educational material in the form of charts books guides and to a lesser extent audio visual material. Any effective change or intervention in the way environment is being taught in schools would require a close linkage between allthese institutions and groups. Effective linkages cannot be legislated but need to be brought about in a pursuasive way so that they are internalised by the various groups concerned. The question therefore, of improving environmental education in our formal institutions is not merely one of preparing good educational material, but that of working closely with this system, of improving and changing various curicula, of re writing textbooks, of training teachers and of making available material integrated into well devised programmes. If this is not done innovative work will remain available to few schools or colleges or remain as demonstration pieces with little effect on the main currents of education in our society. To reach school children, therefore, the first target group of an environment education programme must be the school teachers teacher trainers, and the eduational authorities. Perhaps the best strategy for convincing such a system which has its own inertia and is therefore difficult to change as a whole is to set up demonstration programmes. Our Centre is trying to identify about a 1000 schools across the country that can be both the demonstration centres and the testing grounds for the educational material we will bring out. From July this year, regular week-long training programmes aimed at resource teachers or teacher trainers, especially at the primary school level are being planned

Over the last decade the formation of Nature Clubs has made a very good beginning in India. Through the efforts of the World Wildlife Fund India and other organisations school children are regularly taken to camps and are encouraged to conduct environmental activities in their schools by forming small clubs. The members of such clubs are not the average students, but are those who have got especially motivated or have had the good fortune of being more exposed to environmental issues This network provides a good opportunity of reaching motivated students who, in turn, can be catalytic in motivating several of their school friends.

Visitors to special facilities also provide a good opportunity to reach a motivated group. Visitors to zoos, botanical gardens, wildlife sanctuaries, monuments, and areas of natural interest represent a very select group of the population which if reached at the right time with the right type of information would be willing to listen to and understand environmental messages.

Interpretation of these experiences through well developed interpretive programmes is another focus of the Centre's acivities. To run an effecive interpretive programme, one needs to have good interpretive material which may include exhibits, outdoor or wayside exhibits, printed material, films, signage, etc., but cannot be done without well trained educational officers. This, once again, requires close working together between the Centre for Environment Education and the park authorities programme and run it. Here too, in order to reach the final target group, viz., the visitors to these facilities, one has to first have a programme aimed at raising the awareness of the authorities and the park staff of both the need and the method of interpretation.

Besides programmes for schools, or interpretive programmes, the Centre for Environment Education is involved in programmes aimed at specific target groups in rural and urban areas. Unlike educational programmes aimed at children which have long range benefits and whose benefits are less tangible to quantify. programmes aimed at specific groups have very direct impact and can be measured in terms of their effectiveness and developmental benefits. It is well known that the problem of fuelwood is reaching alarming proportions in this country. Programmes have been launched aimed at both the production and consumption of wood. An effort is being made to afforest vast tracts of wastelands in this country. The government has launched schemes that seek the participation of the village poor in this programme. The technology is known.the funding requirements have also been ascertained and the resource of land available. To implement this programme. a massive educational campaign is now needed. This is an area where environmental education is an essential input into a development scheme. To mobilise the rural poor once again we need to think in terms of network. There are banks and funding agencies. whose support will need to be enlisted in order to make this scheme effective. There are various agencies of goverment that will have to process forms give the resources to the right people and develop attitudes which make cooperation with people possible. Here again, the target group for the environmental education porogramme is not merely the end beneficiary, but the network itself in terms of the workers of the voluntary agencies, the government extension officers and various other instituions that are required before such a programme can become effecitve.

The task then is to create and run programmes in environment education not merely for the final target groups, but also for the network in between whether they be schools, voluntary agencies, goverment departments, business organisations or park authorities. This strategy of environment education which is a two level communication strategy using the country's existing networks to disseminate and run programmes is essential if environment education is to succeed in its objectives.

The Centre for Environment Education is certainly dealing with direct communication using newspapers. radio television, and even folk media. But in this paper, I have stressed the need to deal with the existing institutional framework and become a part of the network of communication which already exists in this country.

INTEGRATION OF ENVIRONMENTAL EDUCATION IN TEACHING, RESEARCH AND EXTENSION IN AGRICULTURAL UNIVERSITIES

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BACKGROUND

Beginning with the Stockholm Conference (1972), there have been several inter-governmental conferences on different environmental issues. The Tibilisi Conference (1977) specifically aimed at Environmental Education and the World Conservation Strategy document released in 1980 emphasized the human behaviour in conserving his environment. Since then several conferences, seminars and workshops have been organised at international and national level. The long term task of environmental education has been to foster or reinforce attitudes and behaviour compatible with the natural world on which human beings depend for survival and well being. Intellectual exercises have recognised legislators and administrators and professionals besides the school children and students as the main targets for their programmes.

Goals of Environmental Education

Though there is no common agreement on the definition of the concept of environmental education, yet the general consensus on its goals are (UNESCO 1977 and UNESCO 1980):

- to foster clear awareness of, and concern about social, economic, political and ecological interdependence in urban and rural areas;
- to provide every person with opportunities to acquire the knowledge (values attitudes commitment) and skills needed to protect and improve the environment;
- to create new patterns of behaviour of individuals, groups and society as a whole towards the environment.

CONTENTS OF ENVIRONMENTAL EDUCATION

According to climatic and geographic conditions, there is need to stress different centers for concentration (Robinson 1983) but the two most important areas to be attended are the concepts and causes of pollution of different types, and management of natural resources.

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ROLE OF THE UNIVERSITIES

The International Workshop on Environmental Education in Belgrade (1975) in general, and the Intergovernmental Conference in Tbilisi (1977) in specific, recommended the role of Universities in achieving objectives of environmental education. These are:

1 To review present potential of the Universities for conducting research. specifically fundamental research, concerning environmental education.

2. Interdisciplinary treatment of the basic problems of interrelationships between people and their environment is necessary for students in all fields.

3 To develop different teaching aids and text books on the theoretical bases of environmental protection for all special fields to be written by leading scientists as soon as possible.

4. To develop close cooperation between different departments, faculties, etc., with specific objective of training experts in environmental education.

5 Close cooperation between different university departments and faculties might assume different forms in line with the structure of the university education in each country, but should combine contribution from physics chemistry, biology ecology, geography, socio-economic studies, ethic, education sciences and aesthetic education, etc.

Specific Objective of the Paper

Universities in countries like India have the added responsibility of taking into account the wide disparities which obtain with regard to the rural-urban orientation, low literacy level, the low pace of development, a wide variety of socio-economic, religious cultural and environmental conditions in designing and developing local specific programmes, contents, material and activities. Agricultural Univesities own special responsibility of propagating the message of environmental education in achieving the goals as Kothari (1966) Commission recommended establishment of at least one agricultural university in each state for educational reforms and development of rural areas of the concerned state. Almost all Agricultural Universities in India have three major objectives:

a. Imparting education in different fields, particularly agriculture, veterinary and animal sciences, agricultural engineering, home science and other allied sciences - TEACHING

b. Furthering the advancement of learning and prosecution of research, particularly in agricultural and allied sciences - RESEARCH

c. Transferring the knowledge generated of such sciences to the rural people or users - EXTENSION

Here, an attempt is made to integrate the contents of environmental education in activities of three major objectives of these agricultural universities to achieve the goals of environmental education. Haryana Agricultural University at Hisar has been taken as a case.

INTEGRATION OF EE IN TEACHING PROGRAMMES

Undergraduate Programme

A perusal of differem courses offered for undergraduate programmes in agricultural university shows that, in general, about 30 to 40% of the total class room instructions are devoted to the humanities and basic and applied sciences: about 40-50% to the core subjects i.e., agricultural subjects or animal science subjects, etc., and about 10 20% to allied programmes (for example an agriculture student given instruction in agricultural engineering, animal science, etc.). The students in the B.V.A.Sc. programme attend only a few courses in the basic sciences as they have necessary training in basic sciences in the Pre-medical/ Intermediate classes

A further perusal of the graduate courses reveals that none of the environmental title, i.e. environmental science, environmental engineering, environmental design, environmental communicatioons, environmental education and environmental studies, is attended from the point of view environmental planning and conservation. Thus the existing status is very poor. At undergraduate level. there is no need of adding courses in Environmental Education. In B.Sc. (Hons.) agriculture, the elements of environmental education may be introduced in courses on Botany, Zoology, Agronomy, Soil Sciences, Entomology and Plant Pathology, Economics, Sociology and Forestry.

In the final year, like other electives option should be given to Environmental Planning and Conservation.

A separate department of Environmental Planning and Conservation should be established in all agricultural universities with a specialist member from the collaborating departments.

Postgraduate Programme

The postgraduate curriculum is directed towards greater specialization. At M.Sc. level out of 50 credits of course work required to graduate (one credit is equivalent to one lecture a week for 3 months), half of it belongs to the field of specialization and the rest is related to the supporting major fields. At the doctorate level, the total course requirement is 36 credits, i.e., about 8 to 10 courses, distributed between the subject of specialization and allied fields.

At postgraduate level, each University should have a post-graduate degree or diploma course covering different courses necessary for it, as is done by some other institutions.

At postgraduate level there must be a composite course covering essential elements of environmental conservation which should be a compulsory course, at least for those postgraduates who deal directly with environmental aspects i.e., Entomology and Plant Pathology, Soil Sciences, Agronomy, Zoology, Climatology, Botany, etc. This would create the awareness and provide basic knowledge of the subject.

Some of the practical pre-requisites for environmental education programme to be kept in mind are:

a. The course content suits the present system of instruction and syllabi i.e.,trimester system and core subjects,

b. Course load does not increase in the present syllabi.

c. Opportunities are given to participate in practial programmes

d. A trained member staff be designated to have responsiblity for planning and coordination.

e. Opportunity is given for taking experiences out of school.

INTEGRATION OF E.E.IN RESEARCH PROGRAMMES

Research in agricultural universities is primarily applied. Various agencies like I.C.A.R., U.G.C., C.S.I.R., D.O.E. and D.S.T. finance researches. These cover a wide spectrum, including studies on pollutants in water and wastewater; environment and waste disposal; analysis of air pollutants; desertification, and biological productivity. The areas in need of priority are: soil and water management, residual impact of chemicals on soil, air and production, farm forestry, biomass and energy, population and poverty, ecosystems dynamics and geography of epidemic diseases.

Agricultural Universities generally examine major issues from regional points of view because each state has its own Agricultural Unviersity. Researches of regional importance can be taken up by these institutons through sponsored projects and students researches.

Some of the major problems of environmental conservation in Haryana region are i) onward march of Rajasthan desert; ii) rising water table; iii) increasing problem of soil salinity and alkalinity; iv) increasing industrial pollution;v) poor awareness of these problems among rural as well as urban people. Several projects at Haryana Agricultural University are in progress but not from this desired point of view. A simple bias towards this problem can give an insight into the processes of environmental conservation.

INTEGRATION OF EE IN EXTENSION PROGRAMMES

An unique feature of the agricultural universities is their extension functions in respective states. This function is primarily educational in nature and includes imparting training to extension personnel. A Director of Extension Education is provided for developing programmes for assisting farmers and housewives in applying results of scientific investigations to the solution of their problems.

Taking into account the extension education objective and responsibility of the University stated above, the clientale to be served by the university within the territory of Haryana State are: farmers; rural women rural youth; rural isntitutions; other rural people; agri business complex; personnel of Government departments and other agencies; and administrators, legislators, and social leaders.

This Directorate comprises of Advisory, Training and Information wings.

Advisory wing has its team of state-level specialists in 12 subject matters at Hissar Campus, and district level specialists at the headquarters of 11 of the 12 districts of Haryana in 10 subject matters. Their activities go down to the village level. They are the University's field workers, representing the remaining two wings of the Directorate as well as their respective subject matter departments and colleges of the University. This set-up at the district level has been given an institutional form and is known as 'Krishi Gyan Kendra' (KGK) or 'Farm Advisory Service Centre', Their activities and accomplishments are many.

Advisory wing may educate the rural people about causes of environmental deterioration and ways and means to check it; alternative sources of fire wood and dung cake; and help develop necesssary attitudes for environmental protection and necessary skills to solve the problems. This wing should also organize activities involving different sections of society through environmental associations of students farmers youth consumers and other community groups.

Training wing is located in the Directorate of Extension Education at Hisar Campus. It is named Institute of Agricultural Technology, Training and Education and has a nucleus of about a dozen teachers drawn from different colleges of the University from major disciplines amenable to extension education. They share their respective subject matter content of various trainings and also liaise with their respective departments for arranging additional resource personnel as and when needed. Training courses are arranged and tailored in accord with the needs and demands of various categories of clientele. These are non-degree/diploma courses, and may be on any aspect of farming, etc. Their duration ranges from one day to 10 months.

Training wing in its programmes may emphasise; basic training in human, animal and plant ecology and interdependence field experiences in the area of environmental sciences; knowledge of environmental issues and problems of resource management; competencies in environmental problem identification, investigation, evaluation and citizenship action; opportunities to develop value clarification, skills and knowledge of the roles of human values in environmental issues

Information wing may develop charts, posters, films slides etc on different aspects of topic and suggest suitable media for dissemination of message to different target groups.

Through their publications the message of environmental education can be disseminated without incurring any additonal cost on the part of client or the organization. Simplest way is to treat and present the material in such a way that message is communicated. Field workers and researchers should be involved to meet the local requirements of the programmes.

Different aspects of environmental education as proposed in the paper can be easily integrated with the present job chart of extension workers, trainers, students and other groups concerned with the agricultural university. We have suggested earlier the integration of environmental education into the curriculum of High Schools (Punia et al. 1982). Similar approach can be adopted for integrating the message of environmental education into the curriculum of agricultural graduates and training programmes of Haryana Agricultural University.

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COMPARISON OF ENVIRONMENTAL AWARENESS AMONG CHILDREN OF NON-FORMAL EDUCATION CENTRES OF M.P. AND MAHARASHTRA

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NTRODUCTION

A study of environmental awareness of children studying in primary schools and nonformal education (NFE) centres was conducted and reported earlier (Gupta et al. 1981). Manuel and Pushpita (1976) reported studies on environmental and non formal science conducted on secondary schools. Since the children studying in the different educational settings displayed almost the same level of environmental knowledge about certain aspects, it was thought appropriate to know whether the children studying at NFE centres of two different geographical areas. Madhya Pradesh and Maharashtra would be influenced in their environmental awareness by the specific geographical conditions and educational aspects like curriculum content, methodology of teaching and difference in their geophysical conditions of living. To find an answer to this problem environmental awareness scores were obtained by using one of the two available environmental tools (Rajput et al. 1981, Singh and Rao 1980). The scores were obtained for the various sub groups on different aspects of environment and then quantitative and qualitative analysis were done in order to identify the diffrent components of the environment on which the children of two settings were doing better or otherwise.

SAMPLE OF THE STUDY

The study was conducted on those children studying at NFE centres who had reached the level of Class IV. Most of these children had not attended any formal school earlier and had reached this level after one and a half to two years of study at their respective NFE centres. Sixty children were drawn from the NFE centres located in Narsinghgarh Block of Rajgarh District of Madhya Pradesh (M.P.) and 54 from the NFE centres located in Chandrapur District of Maharashtra. These centres were run by the Regional College of Education (NCERT) on experimental basis from April 1978 to May 1982.

TOOL USED

For comparing the environmental awareness scores of the

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children studying at NFE centres of M.P. and Maharashtra, a standard environmental awareness questionnaire consisting of 50 test items developed by Rajput et al (1981) was modified and administered to the children. A Marathi version of the questionnaire was used in Maharashtra.

METHODOLOGY

The performance of the children of the two groups was compared after computing their total scores and also on individual test items of the questionnaire. A t- test was applied to study the significance of difference between the sub groups Each question was ranked in terms of performance of all the children present in a group. The first ten and the last ten ranking questions from both the sub-groups were identified and compared with each other. The common content areas appearing in the first ten and the last ten ranking items in both groups were identified.

RESULTS AND DISCUSSION

Comparison of Non formal Rural Group of M.P. (NFRMP) and Maharasshtra (NFRMS)

The number of subjects (N), mean scores (M), standard deviation (SD) and t value for the two subgroups are given in Table 1.

Table 1. Comparison of NFRMP and NFRMS

Subgroup	N	M	SD	t
NFRMP	60	38.78	4.90	2.94*
NFRMS	54	34.59	9.31	

* P= 0.01 df = 112

The t-value indicates that there is a significant difference in the performance of children of these two groups regarding their environmental awareness. The difference may be due to several reasons. One may be the course content in science and social sttudies, and the other may be the approach in teaching these two groups. The third may be the difference in geophysical conditions of the two groups. This is further supported by the ranking of all the questions of the environmental questionnaire. The first ten ranking questions were identified for both the groups. Significant differences have been found in many areas of environmental awareness in the two groups However three aspects of enviroment are found to be common in both the subgroups. These aspects in which the two groups are found to differ in the first ten ranking aspects are given in Table 2. The children of NFR group of Madhya Pradesh (NFRMP) were found to do better on the aspects like type of water that is safe for drinking, direction of sunrise, shape of the earth, source of getting wool and cotton, effect of weather on the growth of plants and different sources of getting water. On the other hand, the children of NFR group of Maharashtra (NFRMS) did better on the aspects of the living place of the dog, relationship bettween rock and soil, animals which do not eat grass, edible portion of the tomato and spinach plants, rotation of moon round the earth and familiarity with wild and domestic animals like cat, dog and elephant.

Table 2. Comparison of NFRMP and NFRMS on the bases of first 10 ranking aspects

Environmental Aspects	Direction of Difference (+) NFRMP	(-) NFRMS
Type of Water that is safe for drinking	+	-
Direction of sunrise	+	-
Shape of the earth	+	-
Source of getting wool	+	-
Effect of weather on plant growth	+	-
Source of getting water	+	-
Source of getting cotton	+	-
The living place of a dog	-	+
Relationship between soil and rocks	-	+
Animal which do not eat grass	-	+
Edible portion of the tomato plant	-	+
Rotation of moon around the earth	-	+
Edible portion of the spinach plant	-	+
Animal out of cat dog and elephant not eating the other		+

(+) indicates its occurrence in the first ten and
(-) indicates its absence in the first ten.

Common Aspects Among the First Ten

The children of both groups (NFRMP and NFRMS) did equally well on aspects like physical characteristics of the newly born child, animal used for guarding the house and the birds which do not make their own nests. This difference may be attributed to the immediate environment of the children in which they are living and with which they are well acquainted. In the first two aspects the children of formal urban and formal rural groups also did equally well. These aspects are related to home environment of the children.

The performance of children of the two groups has also been compared on the basis of last ten ranking aspects as indicated in Table 3. The children of NFRMP did not do as well on the aspects like the reason for giving boiled water to the patients the ability to see time in the watch concept of the rotation of moon round the earth relationship between soil and rocks and the ways of checking iron objects from rusting On the aspects of rotation of moon round the earth and relationship between soil and rocks. the children of NFRMS had performed rather satisfactorily as mentioned earlier. On the other hand the scores of childreen of NFRMS group were found to be rather poor in comparison to that of NFRMP group in the areas; effect of the stoppage of supply of air on the lives of flies functions of teeth. the reason for getting the hand wet on touching a piece of ice distinction betwen different states of matter and the effect of weather on the growth of plants. The children of NFRMP did very well in the areas of effect of weather on the growth of plants, sources of getting wool and cotton. This may be attributed to the fact that the children of NFRMP come from the agricultural belt whereas the children of NFRMS came from the tribal belt.

Table 3. Comparison of NFRMP and NFRMS groups on the basis of last 10 ranking aspects

Environmental Aspects	Direction of Difference	
	(+) NFRMP	(-) NFRMS
Reason for giving boiled water to patients	+	–
The ability to read time in watch	+	-
Rotation of moon round the earth	+	–
Relationship between soil and rocks	+	-
Prevention of rusting of iron objects	+	-
Effect of cutting off the supply of air on the lives of flies	-	+
The main fuction of teeth	–	+
The reason for getting the hand wet on touching a piece of ice		+
Distinction between different states of matter	-	+
Effect of weather on the growth of plants	-	+

Common Aspects Amongst the Last Ten

The children of both subgroups scored very poorly on aspects like the way of finding the direction of flow of wind concept of evaporation of water shape of the earth (application part), reason for no shadow formation in dark and the role of skeleton for a definite shape of the body The children of both formal urban and formal rural groups also fared badly on the first three aspects mentioned above. All these aspects involve the understanding and application part of their knoweledge which does not seem to have developed in the children at this level.

Interrelation of Results and Implications for Curriculum Development

The study has revealed difference in environmental awareness of the two groups of children studying in different geographical regions of the country. The difference in awareness scores may not necessarily be due to lack of knowledge on the part of children but may be due to varied emphasis laid on the teaching at primary level subjects which incorporate in them environmental content. There is need to set up curriculum development groups at district levels Components of environment may vary from block to block, district to district and one region to the other. However, there is need to develop among the students certain abilities, skills and behaviour which help them in observing their environment more keenly. Another implication of the differential performance of the children is that there is a wide range of performance of the children of the two states. Certain key concepts such as conservation energy, pollution and preservation of environment may be developed by incorporating these in different school subjects.

The children of both the groups are found lacking in the application part of their knowledge of their environment. This aspect may also be taken into consideration while framing curriculum. 'Learning by Doing' is a better alternative in developing environmental awareness This would be possible through field trips, nature trails and organising study camps for understanding the environment in its totality biological, physical and social.

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ENVIRONMENTAL PROBLEMS AND THEIR MITIGATION THROUGH UPGRADING ENVIRONMENTAL EDUCATION IN SRI LANKA

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SRI LANKA: A COUNTRY PROFILE

Physical Environment

Sri Lanka, located betweeen 5° 55' and 9° 50' N latitude and 79° 42' and 81° 53'E longitude, is a small island with an area of 65000 sq.km. It has a central mass of hills surrounded by coastal plains. The island is watered by many rivers which arise from the central mountain mass and flow in a radial pattern.

Sri Lanka has a tropical humid climate with no clear seasonal variation. It has a generally high temperature ranging from 26 °C to 28 °C, except in the hill country where the temperature is low according to the altitude.

The island gets three main types of rain: monsoonal, convectional and depressional. The two monsoons, South-west (May to September) and Northwest (November to February) play the vital role in the climate of the island.

Although the climate is humid according to the world climate classification, the island is traditionally divided into two main climatic zones, Wet Zone and Dry Zone, based on the spatial distribution of the rainfall.

Natural Resources

In natural resources, nature seems to have specially favoured Sri Lanka. The most important natural resources in the island include land, water, forest, energy and minerals, etc. Cultivation and plantation of crops like paddy, tea, rubber and coconut, cover over 1.5 million ha and 0.5 million ha land has been irrigated by more than 20 rivers that flow from the hills.

Sri Lanka is famous for precious stones: rubies, sapphires, cat's eyes, moonstones, as well as for such minerals as Kaolin, Silica, Graphite and Mineral Sands. Her beaches are among the finest in the world.

Cultural Environment

Sri Lanka has an ancient civilization and a recorded history

***Secretary, Environmental Council, Central Environmental Authority, Colombo, Sri Lanka* which is more than 2500 years old. In 1815 the island was taken over by the British who ruled here for over 130 years. Since Independence in 1948, Sri Lanka has been one of the most stable countries in Asia.

Sri Lanka has a multi-national and multi-religious population of about 15 million. The Sinhalese (74%) constitute the majority and Tamils rank next (12%). Buddhism is the main religion and accounts for about 70% of the total population. Hinduism ranks next with 15%.

Gradual decrease in the population growth is one of the most remarkable demographic features of the country. The natural population increase rate was about 2.1% in 1970 and 1.7% (annual average) in the late 70s.

Relatively high rates of birth, literacy, life expectancy and very low rates of death, infant mortality, maternal mortality are other significant features in the demographic profile of the country.

Significant spatial variations in the population distribution could be identified. A large proportion of the total population in concentrated in the southwestern part of the island (Wet Zone). Both physical and cultural features have influenced the distribution pattern of the population.

FACTORS LEADING TO ENVIRONMENTAL PROBLEMS IN SRI LANKA

From the very beginning of the ancient civilization that was based on traditional agriculture, the people were close to nature that povided food, clothes and shelter to them. Subsistence form of agrarian society helped the harmony between nature and human beings.

Environmental problems are relatively new in SriLanka. During the first half of the century, problems related to environment had begun to emerge. Although, there have always been certain expressions of concern for issues related to environment, serious environmental problems could not be visualised before the second half of the 20th Century.

During the last three decades, new environmental problems have begun to emerge and problems which already existed took an entirely new dimension. Most of the environmental problems have emerged and developed as a result of following causes:

Pressure of Rapid Population Growth

This could be regarded as the major source of environmental degradation of Sri Lanka. The population of Sri Lanka has doubled in the last 25 years and is now 15 millions. The density of population has risen to 217 per sq.km. The availability of per capita arable land has reduced to 1/6 ha in 1980. This is indeed a very small amount for an agricultural country.

Accelerated Development

The accelerated development effort launched by the Government has generated its own environmental disturbance. Some of the recent problems related to the environment are directly connected with this situation. The sudden expansion of economic activities resulted in the depletion of valuable natural resources such as forest, agricultural land, wildlife and arable soil.

Modernization of Economic and Social Activities

Modernization has spread out to almost all the corners changing economic and social activity in the island. These especially affect the agriculture, industry, transport and urbanization.

Urbanization

Although Sri Lanka has successfully controlled the rapid urbanization process so far, environmental problems related to the urbanization are a common phenomenon in Sri Lanka. Pressure of population growth in the urban areas causes serious environmental problems such as the growth of marginal settlements (e.g. slums, shanties) where the sanitation and other facilities are minimal. The spread of unplanned and uncontrolled human settlements have led to the development of suburbs and an urban fringe while the inner core of the city suffers from blight and slum conditions.

Changing Patterns of Living Standards

With the influence of the western commercialised civilization, requirements of people have expanded and demand for natural resources have increased. This type of changing attitudes have made it simple for people to destroy the natural environment not only in normal cultural behaviour but even in industry and trade.

Poverty

Poverty itself is one of the main causes of environmental problems, especially in marginal settlements where the poorest people live without essential requirements such as pure water, shelter, clothes and food. Minimal sanitation facilities have created a number of acute environmental problems. The pressure of growing numbers of urban poor has resulted in environmental degradation of the whole area.

Unawareness of Environmental Problems

In Sri Lanka, for a long period of time in the recent past, there has been little awareness of the close relationship that should be maintained between man and the environment. Unplanned and environmentally unsound development has taken place without considering the environmental aspect. This has led to a reduction in the natural diversity and degradation of the environment. Most of the problems related to the environment have not been considered with a full awareness of their consequence on natural resources and human health. It is often contended that the environmental problems are connected with the industrialized countries. The absence of a proper legislative framework and an administrative mechanism for the protection of the environment was a direct result of the unawareness of the environmental problems in Sri Lanka.

Industrialization

The process of industrialization that took place during the last decade has created serious environmental problems in Sri Lanka. The pollution of air, water and land by the discharge of untreated effluents and wastes has had an adverse impact on environmental quality in the island.

MAJOR ENVIRONMENTAL PROBLEMS IN SRI LANKA

Deforestation

The increasing loss of forest cover can be considered most important environmental problem in Sri Lanka. Widespread deforestation that accelerated during the last 3 decades has reached a critical level. Sri Lanka has lost one million hectares of natural forest during the last 3 decades allowing the erosion of valuable top soil, to increase floods to destroy the habitat of wildlife and to threaten the existence of fauna and flora in Sri Lanka.

The forest cover in Sri Lanka has reduced to 21% of the total land area from 44% in 1963. Shifting cultivation, accelerated agricultural development, spread of village settlements have depleted forest cover to almost critical levels. Population growth and intensified agricultural development have been responsible for a good amount of deforestation in the island. Specially in the hill country, the clearing of forsts has created such acute environmental problems as widespread soil erosion accompanied by increased seasonal flooding, siltation of river beds, reservoirs and decreasing river flows.

Deforestation has also affected human activities by destabilising water flows, silting of reservoirs and agricultural network, depleting groundwater, intensifying floods and aggravating water shortage during dry seasons. Population pressure has threatened the natural forest and its future existence. The growing rural population has had no alternative other than the clearing of the forest for their requirements of agricultural land, firewood, grazing animals, construction of shelter and other purposes.

It is clear that this trend would expand in the near future. Our existing land use patterns have not been very favourable for the existence of forests. The situation gives very little hope for the conservation of forests in Sri Lanka. The responsible management of forest resources has become an urgent need.

Soil Erosion and Deterioration of Soil Fertility

Deterioration of soil fertility and erosion ranks as one of the most widespread environmental problems in Sri Lanka. There is clear evidence of erosional processes such as rain wash and gully erosion, etc., and fertility loss of agricultural areas as consequences of integrated human activity. The accelerated development and environmentally unsuitable agricultural practices have direct connections with this problem. Large-scale clearing of forest for development projects and chena cultivation have accelerated soil erosion.

Specially, in the hill country plantation crops such as tobacco, tea and cocoa result in soil losses. The Gem mining is also one of the main causes for soil depletion in some parts of the island. Soil erosion has wasted several million tons of fertile soil increasing siltation in river beds and reservoirs and also reducing fertility and productivity of the soil.

Depletion of Water Resources

The problem of water resources in Sri Lanka is increasing. This has been caused by accelerated development and population increase. The effect of deforestation has obviously led to intensified flooding and severe drought.

Water shortage is a critical problem in the dry zone while the problem of water logging and damage affects the wet zone.

The main cause of deterioration of water resources is pollution. During the last two decades water pollution problems have been increasing. Today, water pollution can be considered as the most critical environmental hazard in Sri Lanka. It is the direct result of discharge of untreated industrial effluents, indiscriminate use of agricultural inputs, and pollution caused by human settlements.

Discharge of Untreated Industrial Effluents

Various forms of industrial pollution include discharge of heated effluents, synthetic pollutants, pathogenic organisms, oil, addition of inert, insoluble materials and readily degradable orgnic matter. Evidence has proved that the industrial pollution of water has been a hazard in the past and is likely to be more hazardous with the rapid development of industries.

Indiscriminate Use of Agricultural Inputs

Pollution of water and waterways through agriculture is also common in Sri Lanka. Although DDT has not been found in water and wells, fertilizers, pesticides, weedicides and other chemicals applied for cultivation of various crops are often washed into waterways through runoff and seep down to ground water by percolation. Addition of pathognic organisms, synthetic pollutants and readily degradable organic matters through the agricultural practices have polluted the water resources.

Pollution caused by Human Settlements

Water pollution caused by the spreading human settlements has become a serious environmental hazard in Sri Lanka. Improperly treated sewage and the dumping of garbage have made various water-borne diseases more acute. The addition of readily degradable organic matter found in human and animal waste dissolve in the water and reduce the life-sustaining capacity of the water.

Water pollution can be divided into four main categories:

1. Pollution of rivers and other waterways.
2. Pollution of drinking weater sources.
3. Pollution of ground water.
4. Pollution of lakes and reservoirs.

Air Pollution

Pollution of air is also gradually becoming a serious environmental problem especially in urban areas in Sri Lanka. Vehicle fumes and industrial effluents are the causes of air pollution. Evidence has proved that various conditions it has exceeded the tolerable limits in the Colombo Metropolitan area.

Air pollution is mainly caused by toxic materials and various gases, acidic fumes and fuel emissions discharged by industries. Specially industries such as asbestos, rubber processing, tyre retreading are some of our main air polluting causes. Some State-owned large industrial establishments, e.g., cement factory, fertilizer mixing plant, caustic soda factory and oil refineries, are major sources of air pollution.

Marine Pollution

Pollution has also affected the marine environment in Sri

Lanka. The rapid coastal development could be seen during the last three decades. Tourist industry has expanded tremendously. Coastal settlements have spread due to population pressures. The urbanization trend in coastal zones is being accelerated. Estuaries of the rivers have been dammed for development. Coral mining has increased.

All these changes have affected the natural environment in the costal zones. While natural ecosystems have been disturbed genetic diversity has reduced. Natural resources in the coastal zones have deteriorated while the stability of the environment is being depleted.

Valuable corals and mangroves have been exploited exceeding their renewable capacity. Coastal water is being continuously polluted due to the discharge of garbage, untreated industrial effluents, oil and other human wastes.

Problems Relating to Urbanization

Unplanned urbanization and the spread of uncontrolled human settlements have led to the growth of high density suburbs while the inner core of the cities suffer from blight and slum conditions. In Colombo, the largest city in Sri Lanka, almost 50% of the population lives in slums and shanties, creating numerous environmental problems.

Pollution caused by the disposal of solid waste is also a critical environmental problem related to urbanization. Very little consideration has been given so far to this problem as garbage is mainly used for filling low-lying areas. However, when disposing solid waste serious consideration has not been given to the possibility of toxic chemicals leaking into groundwater.

Environmental Problems Relating to Mining

Major environmental damage can be identified from the mining activity for Gems, Sand and Coral.

A. Gem Mining: Unplanned (mostly illicit) gem mining spread in most parts of the country has damaged the environment and natural resources. In addition to disturbing the earth's surface it has been responsible for heavy soil erosion, damaged river beds, spreading health hazards, impairment of scenic beauty etc.

B. Sand Mining: Mining and collection of sand from rivers and beaches for construction industry have created environmental problems. They reduce supply of sand available for natural building of beaches as a esult of reducing the sand, coastal erosion is accelerated.

C. Coral Mining: Mining and extraction of coral has increased during the last 2 decades and as a result the problem of the depletion of coral reefs, degradation of an important element of environmental attraction and coastal erosion has developed.

Desertification

Although Sri Lanka does not face serious desertification problems such as desert encroachment and sand drifts, encountered by some of the African countries, certain trends of desertification could be identified in the dry zone and intermediate zone in the island. Increasing soil salinity and soil alkalinity, gradual change of vegetation cover, increasing soil erosion and effects on groundwater storage are some of these trends related to the desertification.

EFFORTS FOR THE PROTECTION AND MANAGEMENT OF THE ENVIRONMENT

The efforts and the countermeasures taken in the recent past for the protection and management of the environment in Sri Lanka could be broadly divided into four main categories.

(a) Formation of a stable National Environmental Policy in Sri Lanka.
(b) Strengthening of legislative framework in the field of Environment.
(c) Establishment of an institutional framework for the protection of the Environment.
(d) Upgrading of Environmental Awareness.

Formation of National Environmental Policy in Sri Lanka

The need for environmental protection is clearly stressed in the new Constitution of Sri Lanka. The Constitution of Democratic Socialist Republic of Sri Lanka in Chapter 6 article 27(14) makes the following provisions.

> "The State shall protect, preserve and improve the environment for the benefit of the country."

Article 28(f) of the Constitution states;

> "The exercise and enjoyment of rights and freedom is inseparable from the performance of duties and obligations and accordingly it is the duty of every person in Sri Lanka to protect nature and conserve its riches".

The Hon. Prime Minister of Sri Lanka issued the basic policy guidelines on 12th August, 1980 when the National Environmental Act came into operation.

Strengthening the Legislative Framework

As mentioned earlier, in Sri Lanka there are only scattered provisions relating to pollution control, natural resources management and environmental planning. Most of these statutes contain sanctions to prosecute the violation of their provisions. However, it is a regrettable record that many laws pertaining to the environment are not sufficiently enforced.

After 1980, Government has enforced several Acts which directly deal with the environment. The National Environmental Act (NEA) of 1980 which is the basic law for environment was enacted with effect from 12th August, 1981.

Several other recent laws, the Coast Conservation Act No. 57 of 1981, Natural Resources, Energy and Science Authority Act, Marine Pollution Prevention Act and National Aquatic Resources Research and Development Agency Act, can be considered valid examples.

The experiences of the last two years show that the role of the CEA for the protection and management of the environment has to be further strengthened by enabling legislation on environmental policy and environmental protection. Having considered the existing legislative framework and alternative solutions, it has been proposed that the powers and functions of the CEA be strengthened by inclusion of following:

a. to be responsible for and co-ordinate all activities relating to the discharge of wastes into the environment, and for preventing or controlling pollution and protecting and improving the quality of the environment;

b. to issue licences to control the volume, types, constituents and effects of waste, discharge, emissions, deposits or other sources of pollution and sub-sources which are of danger of potential danger to the quality of the environment or any segment of the environment;

c. to require the submission of all plans for major projects and proposals and for changes in or abandonment of existing projects for evaluation of the beneficial and adverse impact of such plans or projects or proposals on the environment;

d. to require any local authority to comply with and to give effect to any recommendation relating to environmental protection within the local limits of the jurisdiction of such local authority and in particular any recommendations relating to all or any of the following aspects of environmental pollution:

- i. the prohibition of the dumping of litter waste, garbage and sewage;
- ii. the prohibition of pasting of posters or bills on walls or buildings;
- iii. the prevention of the discharge of untreated swage or substandard industrial effluents into canals or waterways,
- iv. the control of the pollution of the atmosphere.

e. to require all agencies and instruments of the Government, as well as private corporations, firms and entities to prepare, and file and include in every action project or undertaking which significantly affects the quality of the environment the detailed statement on:

i. the environmental impact of the proposed action, project or undertaking.

ii. any adverse environmental effect which cannot be avoided should the proposal be implemented;

iii. alternative to the proposed action;

iv. a determination that the short-term use of the environment are consistent with the maintenance and enhancement of the long-term productivity of the same; and

v. whenever a proposal involves the use of a non-renewable resources, a finding must be made that such use and commitment are warranted.

Establishment of an Institutional Framework

The NEA No. 47 of 1980, provided for the establishment of the CEA. This Act came into operation with effect from 12 August, 1981. The establishment of CEA as a policy making and a co-ordinating agency for the environmental protection and management filled a wide and long standing gap created by the absnce of an Institutionaal Framework, for co-ordination of environmental policy making and programming in Sri Lanka. The CEA has been established under the Ministry of Local Government, Housing and Construction, which is under the Hon. Prime Minister.

Powers and Functions of the CEA

Legislative Framework: The National Environmental Act provides broad powers, functions and duties for the protection and management of the environment. The Act which stablished the Central Environmental Authority provides that the authority, in addition to administering the Act should:

- recommend to the Minister national environment policy and criteria;
- undertake surveys and investigations relative to prevention of pollution;
- conduct, promote and co-ordinate research on environmental matters;
- specify environmental quality standards, and criteria;
- publish reports and information;
- assure compliance with provisions of the Act through investigations and inspections;
- sp sampling and testing methods;
- provide the public with information and; education about environment;

- co-ordinate with other countries and international organizations on environmental matters;
- report to the Minister on environmental matters and suggest any legislative amendements;
- promote, encourage, coordinate and execute long-term planning related to environmental protection and management;
- encourage, promote and give effect to methods for converting and using residues.

Environmental Council

The NEA under Section 7 provides for the establishment of an Environmental Council to (a) generally advise the Authority on matters pertaining to its responsibilities, powers, duties and functions and (b) to advise on any matter referred to the Council by the Authority.

The Environmental Council was established in 1982. Linkage with other implementing Ministries and Agencies have been maintained mainly throgh the Environmental Council. The Environmental Council has Members from the following Ministries:

Ministry of Lands and Land Development, Power and Energy, Highways, Health, Education, State (Tourism and Wildlife), Local Government, Housing and Construction, Labour, Finance and Planning, Plan Implementation, Industries and Scientific Affairs, Textile Industries, Agriculture, Transport, Foreign Affairs, Fisheries, and the Ministry responsible for the Free Trade Zone. In addition, the Council has three members representing non-governmental organizations. The Director General of the CEA, who is its chief executive, is also a member of the Council and provides the link between advisory and implementation processes. The Environmental Council meets at least once a month, and provides advice as well as co-ordination of environmental activities among large number of related Ministries. In addition the members of the Council act as the focal points in their respective Ministries for environmental activities and are responsible for the monitoring of environmental programmes in their own sectors of activity.

District Environmental Agencies

The NEA has provided for the establishment of District Environmental Agencies with Government Agent who is the principal state officer for the supervision and co-ordination of district activities, as the Chairman. The CEA has entrusted the following powers and functions to the District Environmental Agencies (DEAs):

a. Collection of data and information on the Environment and Natural Resources at the District Level:

b. Monitoring the action programme of the CEA at the District

Level as directed by the Authority:

c. Examining cases of enviroinmental impact of various public and private sector activities in the District and submitting proposals for the environmental protection and management;

d. Advising the Authority promptly, if events of significant environmental interest taking place in the districts and especially those which may have significant adverse environmental impact on natural resources;

e. Undertaking inquiries and examination of environmental issues or subjects referred to the Agencies by the Authority;

f. Planning and implementation of an environmental awareness program at the District level with the approval of the Authority;

g. Assisting the Authority in studies, surveys and reserch projects on the environment at the District level.

UPGRADING ENVIRONMENTAL EDUCATION

Successful implementation of environmental programmes ultimately depends on the willingness of people to support, carry out and continue such programmes. No amount of environmental legislation or imaginative protection, organisation, direction and support in the actual implementation of programme activities without public co-operation and assistance.

Awareness of the importance of environmental management and protection is obviously necessary, however, awareness appears to be of little concern to the majority of Sri Lankans who participate in and are affected by environmental changes. This is a compelling reason for reversing seriously declining situations through public education of those most directly involved and affected by development activities, local officials and people at operating and grassroot level. Therefore, awareness of the environment and also of the importance of environmental management, protection and conservation have been urgently needed. The priority has already been given for the launching of a programme for the improvement of awareness on environment through inclusion of environmental concerns into formal education systems and launching of public awareness programmes.

Improvement of Awareness on Environment

The efforts taken place to improve the awareness of Environment can broadly be divided into two groups -

A) Improvement of formal Environmental Education.

B) Public Awareness Programmes of various Institutions.

Environmental Education in SriLanka

The main purpose of Environmental Education is to create and enhance the awareness of citizens to their own responsibility for protecting and managing the environment in the island so that they could participate in actions to solve their environmental problems.

Environmental Education in SriLanka can be divided into four main categories.

A) Primary level
B) Secondary level
C) Higher level
D) Professional training

Primary Level Environmental Education:

The Educational programmes have been evolved to create a growing environmental awareness instudents as they move upwards in the primary and secondary education level. At the primary level, a spiral curriculum encompasses the following topics :

a) Location of school and nature of houses around it.
b) The material of which the houses are made.
c) Water and its uses.
d) How water is polluted.
e) Streams, rivers and lakes.
f) Cultivation.
g) Local food.
h) Pots and pans.
i) Local transport.

Environmental Education in the sense of educating children in continual relationship to their environment, taking them out of the classroom as a normal and regular practice and relating children's education in school directly to personal experience outside is evident in most primary schools to some degree.

The curriculum of the primary level has been revised recently by including a subject area entitled Environmental Activities'.

B. Secondary Level Environmental Education:

At the secondary level, environmental dimensions have been integrated into the different subject areas in the school curriculum. These have been done either by introducing new courses of environmental studies or sciences, after aiming at the Examinations at the General Certificate Examination - Ordinary Level (GCE/OL) and the General Certificate Examination - (GCE/AL) or by introduction of environmental concerns in the subjects such as Geography, Biology and to lesser extent History, general studies etc. A new subject on Environmental Ecology has been introduced recently for GCE/AL Examination.

Although the traditional curriculum of the formal school education system lacked much environmental contexts, the science curriculum launched in the early sixties emphasized the imparting of knowledge skills and behaviours concerning the environment, specially through the secondary school biology curriculum. During the early 1970s further environmental concepts were introduced in the existing curriculum in the science and social studies. Inclusion of Ecology as a subject in the GCE/AL Examination is one of the significant steps. The schools have also been requested to intoduce subjects - Marine and Inland Fishing into their curicula in an effort to inculcate and sustain the importance of the younger generation in the Fishing Industry.

Higher Level Environmental Education:

At an undergraduate level, general environmental courses and modules are offered in the Biology and Botany departments in the Universities. At the University of Colombo, Department of Botany conducts a course for third year undergraduates on "Man and Environment".

Most of the Universities in Sri Lanka conduct educational programmes for their first year students, designed to provide a basic knowledge in environmental relationships.

As for future activities, the Ruhunu University plans to inaugurate a Faculty of Fisheries.

In post graduate level education, there had been significant steps with degree courses in environmental studies or sciences being well stabilised in the Universities. Increasing attention is being paid to environmental themes in the Universities. At present, there are several Universities which offer M.Sc. courses in the field of environment:

a) An M.Sc. course in Environmental Sciences conducted by the Dept. of Zoology of the University of Colombo.

b) An M.Sc. course in Forestry conducted by the Biology Dept. of the University of Sri Jayewardenepura.

c) An M.Sc. course in Town and Country Planning conducted by the Moratuwa University.

d) An M.Sc. course in Environmental Geography at the University of Moratuwa.

There are also several post-graduate Diploma courses related to environment that are being conducted by the Universities in the island.

Professional Educational Training

Efforts to reach specific target groups outside the school system are reflected in the training programmes in the government sector. They range from Civil Service Staff College to sectoral training and research institutes. The Agricultural In-Service Training Institutes of the Department of Agriculture disseminate environmental education in the field of subsistence agriculture through the demonstration and application of soil conservation measures. Similarly, the Tea Research Institute, Rubber Research Institute, Coconut Research Institute and National Institute of Plantation Management are involved among other things in the dissemination of environmental information through the improvement of cultural practices in their respective fields of activities, by the inclusion of topics such as soil conservation, ecology, productivity, waste disposal and recycling, use of alternative sources of energy in processing activities etc.

In-service training at the above institutes may take various forms: (a) seminars and workshops, (b) intensive, short study sessions, (c) field demonstrations, (d) advisory services to farmers, (e) training of extension workers. The in-service trainees at these institutes act as catalysts, contributing to the development of environmental knowledge.

Environmental dimensions have been introduced into the induction and in-service training programmes for public officers at the Sri Lanka Institute of Development Administration (SLIDA). Marine environment is one component in the training module on environment for the new recruits to the Sri Lanka Administrative Service. One course in the Diploma in Public Management offerred by SLIDA for middle and senior public officers has the following module on environment with a section on the marine ecosystems.

Diploma in Public Management, Economic
and Social Development

Module: Environment

(a) Concept of Environment ana Development
(b) Agriculture, Forestry and Land Use
(c) Water - Its Use and Misuse
(d) Marine Ecosystems
(e) Impact of Tourism on the Environment
(f) Causes, Effects and Control of Pollution

In addition to the above, the "Project Planning and Implementation" programmes incorporate a session on environmental asessment of development project. 'At the National Institute of Business Management (NIBM), training modules have been structured to incorporate environmental dimensions. For this purpose, the total discipline of Production Management has been split into eight sub-Modules as follows:

1. The need for Managing the Environment - A system approach.
2. The Environment Dimension in Production Management
3. The Environment Dimension in Designing Outputs: Designing Products
4. The Environment Dimension in Process Design
5. The Environment Dimension in Designing Production Systems
6. The Environment Dimension in Designing & Controlling

Human Inputs.

7. The Environment Dimension in Managing Production Systems.
8. The Use of Operations Research in Planning and Developing Environmentally Sound Production Systems.

About 3000 participants, consisting of employees in the public and private sector enterprises enroll in the NIBM training programmes annually. Environmental components have thus been introduced into the training curriculum of senior managerial and administrative personnel in the state and corporation sectors in Sri Lanka.

ENVIRONMENTAL AWARENESS PROGRAMMES AND CAMPAIGNS

The CEA, has identified the creation of Public Awareness in environmental matters, as a top priority item in its agenda. The basis for the Environmental Awareness Programmes and Campaigns is the unerring recognition that the masses should be persuaded to adopt and environmentally sound style of life.

The end-aim of the Public Awareness Programme for Environmental Management and Protection (PAPEMAP), is to bring about a concerned alertness to environmental issues at mass level. This eventually leads to practices that will mitigate environmental hazards and lessen adverse impacts on the environment.

PAPEMAP, is one of the eight action programmes in the 1982 Five Year Plan of the CEA. The project objectives of PAPEMAP are:

(a) the evolving of a strategy for a national and local level Public awareness Programme and a plan for the implementation of the strategy;

(b) the preparation of a training programme, based on the problem solving process at the local level; and

(c) designing and creating public awareness materials.

As a preliminary step in the implementation of PAPEMAP, a survey was made in all the districts, with the assistance of District Environmental Agencies (DEA). The purpose of the survey was to formulate an environmental profile for the Nation as a whole. To gather information on district basis a questionnaire drawn up by the CEA was sent to DEAA for distribution.

The Media Campaign of PAPEMAP involved the preparation of an awareness package for media materials. In this the media materials are created to generate public awareness in those environmental sectors, that have been identified as priority areas and persistent environmental problems.

The identification was done in terms of the response to the DEA Questionnaire.

The priority sectors are :

a. Deforestation: including forest fires, wood-cutting and chena cultivation.

b. Soil Erosion: including upland erosion leading to siltation, downstreams and chena cultivation.

c. Water Pollution: including contamination of water supply.

d. Inadequate Biomass Management: includes solid waste disposal.

The media material developed for the Campaign will include: Videotapes, Slide/sound presentations, 16 mm films, Posters, charts, brochures, and exhibits.

The media materials will be field tested before they are utilized at national level.

Parallel to PAPEMAP, the CEA also conducted other awareness campaigns which included an exhibition and competition of photographs on environmental themes, environmental film competition, an exhibition on recycling and an exhibition on the status of the Environment in Sweden.

Public talks, seminars and workshops too are being conducted as part of the Campaign to bring about Environmental Awareness.

Three major seminars formed part of the CEA campaign towards Mass Environmental Awareness:

1. Sweden - Sri Lanka Environmental Week
2. Seminar for Media Personnel
3. Seminar for representatives of environmental NGOs

Coastal problems and Marine ecosystems have almost always been a thematic area in most of these Public Awareness Campaigns.

Role of Non-Governmental Organizations

The CEA has identified voluntary Non-Governmental Organizations active in the field of Environment. Some of these have environment as their total focus and others treat environment as only one of their areas of interest.

Several NGO's specialised in a particular segment of environment - forests, trees, water, soil etc.

The CEA has registered those NGO's that could be considered outstanding. Their role is largely to create public awareness and alertness. Some active groups implement such programmes as tree planting. The most constructive role they play is being alert to the least possible damage to environment. Through their concern they get the members of the public and state to take note of the environmental status. The authorities, as a result, are kept informed of environmental problems and can initiate mitigatory measures in time.

The CEA has formulated an action plan for NGO's. As a direct outcome of a National Seminar for NGOs jointly sponsored by the CEA, Sri Lanka Foundation Institute and Earthscan-London, an Apex body to unify all environmental NGOs has been set up. The work of this body will be reviewed by the CEA.

Role of Mass Media

The initial role of Mass Media in Environmental Awareness is to create an intense alertness to environmental hazards and mitigatory methods. The role that the media should play could be identified in specific terms:

1. Highlighting of environmental degradation through feature articles, interviews, news items, etc.
2. Drawing public attention of constructive roles by individuals and groups in bringing about sound environmental well-being.

For these each media organization could have its media cell. Brief items both in print media and electronic media are effective. These could be identified as media bursts. Identification of environmental villains and heros could be effective in mass media towards environmental well-being. Environmental themes could be communicated through newspaper columns, radio features and television programmes. The most effective method in which media can communicate the message of environment is through personalization, where an individual can identify himself with the given environmental issues.

CONSERVATION AND DEVELOPMENT OF NATURAL RESOURCES OF SRI LANKA

Vinod Galapitage*

INTRODUCTION

Sri Lanka is a country rich in natural resources such as productive land, water, fauna and flora. The rapidly increasing demand for natural resources will necssitate the utilization of our natural resources to their fullest extent. In order to ensure that our natural resources are utilized in a sustained manner, it is necessary to pay adequate attention to their conservation. This has become more important in developing countries such as Sri Lanka where the policy makers are giving more emphasis to the exploitation of natural resources to find quick solutions to current economic problems at the expense of future generations.

However, it is encouraging to see that majority of policy makers in Sri Lanka are paying attention to conservation as much as the attention they pay to economic development. This paper attempts to explain the need for the conservation of natural resources such as coastal ecosystems, wild life, forest, land and water in Sri Lanka and the stratetgies adopted by various government institutions for their conservation.

COASTAL ECOSYSTEMS

Sri Lanka's coastal belt is approximately 990 miles long and consists of many low lying areas which are identified as complex ecological systems such as lagoons, salt marshes and estuaries. In the off-shore area there are systems such as coral reefs, oyster and other shell beds, rocky islets that are considered to be natural resource systems unique in nature. Since more than 50% of Sri Lanka's population is concentrated in the coastal areas in urban centres, townships and fishing centres, there is extensive pressure of human activity on majority of these systems.

The Government established a separate organization, the Coast Conservation Division of the Ministry of Fisheries, in January 1978 for the preservatiion, restoration and development of the natural resources of Sri Lanka's coastal belt.

Current Activities and Policies Implemented

Coral mining is carried out at present extensively in the south-west coast and in isolated places on the south coast. These activities cause disastrous effects on the offshore marine environment. The problem of mining and collection of coral for the production of lime is identified as a complex socio-economic problem. The Government recommended alternative employment for those involved in this activity. Attempts have also been taken to develop other alternative products as substitutes to lime from coral for building and other applications. Also the Government has prohibited the use of coral lime in construction of state buildings and those under Government contracts.

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Sand mining from the major rivers reduces the amount of material needed to replenish the beaches where these resources are transported by the drift, currents and waves. Excessive and uncontrolled mining of sand contribute to coastal erosion and therefore enhance the environmental damage in the coastal areas. This problem is most intense on the south-west coast. Studies are now being carried out on the effects on sand mining in the Kelani River, which enters the sea a few miles north of Colombo.

The construction of unplanned environmentally hazardous structures has led to coast erosion in adjacent areas in most instances. Therefore at present such construction activities are approved (by the Coast Conservation Division) after careful study of enviroinmental impact.

Mangrove swamps important as natural ecosystems supporting and sustaining the fishery, wildlife and other living aquatic resources are destroyed where such land is acquired and filled for construction and other infrastructure facilities, e.g. Batticaloa on the east coast and Negombo on the west coast.

Dredging of lagoons could lead to the disturbances of biological systems in these brackish water bodies and cause irreversible damage and therefore the Coast Conservation Division has recommended extensive surveys prior to dredging.

Removal of submerged limestone deposits is carried out near Puttalam in the north-west facing one of the most productive fishing grounds and an extensive fishing centre. There had been attempts in the past to quarry rock for use in the construction industry but the Coast Conservation Division's intervention prevented the spread of this activity.

Coastal vegetation forms an integral part of the coastal zone and is a neglected resource. Damage to coastal vegetation is caused mainly due to lack of awareness and the Coast Conservation Division has launched a programme for creating awarenes in this respect.

Actions That Need Implementation

1. Determination of the impact of sand mining in coastal areas and estimation of the social cost of sand resurces. Identification of alternatives to and substitute material for sand.
2. Environment impact assessments to be carried out for all deve-

lopment projects undertaken in the coastal areas.
3. Formulation of a plan for management of coral mining on coasts of Sri lanka.
4. Information on the extent of fishing to determine exact situation before formulating strategies for its management.
5. Sand mining areas that are most hazardous, damaging the environment, should be declared as natural reserves.
6. Quarrying of rock should be totally stopped.

WILD LIFE

Wild life is an integral part of the natural ecosystem. Wild life species are presently threatened to decline due to rapid destruction of habitat, exploitation for illegal export, etc.

Wildlife Protected Area

The Department of Wildlife Conservation enforces laws relating to the protection of Wildlife and Wildlife Reserves of Sri Lanka. Basically there are two types of protected areas for wildlife: National Reserves and Sancturies.

National Reserves

By virtue of the term 'National', the land within them belongs to the State as opposed to 'Sanctuaries' in whch private land may be included. National Reserves are of four kinds:

1. Strict Natural Reserves are not open to the public and permits are issued only to enter for scientific study or to officers of the Department for inspection. Examples are some sections of Yala, Hakgala, and Ritigala.
2. National Parks strictly protect the fauna, flora and mineral deposits. However, the general public may enter them for purposes of observation and study. Certain parts of the park are developed for tourism ina way which will not disturb or scare the animals.

   There are at present six National Parks from the larger Yala and Wilpattu Parks with over 350 sq. miles each, through the much smaller Uda Walawe, Gal Oya and Maduru Oya National Parks to miniature Lahugala National Park of 6.4 sq. miles - a permanent habitat for some 150 elephants. At present, nearly 40% of the forest area of the country is reserved purely for wildlife management.
3. Nature Reserves are very similar to National Parks but with the difference that any ongoing activity on State land within it may continue on a special permit. Under this the Department has given protection to the unique Horton Plains and Sri Lanka's second highest peak Kirigalpoththa (7500 ft).
4. Jungle Corridors were first established in 1970 to allow

the marsh or villu elephants from the Tamankanduwa plains to reach the Maduru Oya at the height of the dry season. The linking of Reserves or Habitats is a far-sighted conservation measure and Jungle Corridors give animals the option of moving from one home range to another.

Sanctuaries

A marine sanctuary at Hikkaduwa on the west coast was established in 1979 to control the exploitation of marine resources.

Public Interest and Participation

The people interested in nature, wildlife and natural history have formed themselves into societies known as non-governmental organization (NGO) and play an active role in educating the public campaigning against forest denudation, pollution, destruction and so on. The Department works closer with NGOs in its conservation efforts.

Wildlife Conservation Policies and Guidelines

1. Protecting specis whose population may not survive if they are exploited for financial gains, e.g. elephants for tusks, exotic fish.
2. Affording protection for species that will reach critical levels if their habitat is denuded, e.g. wild elephants.
3. Setting aside sufficient, suitable natural habitats for the survival of fauna and flora.
4. Undertaking scientific studies with educational institutions. The Department is looking into the possibility of breeding elephants in captivity. The elephant orphanage (at Pinnawela) will be setting up the breeding centre.
5. Promoting an understanding of the Departtmnt's functions among the public with the cooperation of non-governmental organizations.
6. Establishing wildlife refuges, e.g. streams where indigenous or endemic fish species breed, fish exporters catch the fish to the point of elimination. Important mangrove swamps which are in danger of being reclaimed for building purposes can also be declared a refuge.
7. For management of wildlife reserves it is necessary to determine the carrying capacity of reserves. It is vital that scientific census of wild animal population be undertaken using both direct and indirect methods. Wildlife ecologists will have to decide on the population that the wildlife reserve can accommodate without causing natural disasters.

FORESTS

Forestry Status in Sri Lanka

Forest cover in Sri Lnaka has progressively diminished over the decades owing to clearing of natural forests for irrigation, land settlement and other development schemes. In 1956 with a population of 8.1 million, the forest cover was approximately 44 percent. Since then heavy inroads have been made into forest area both for development and shifting cultivation. In 1982 with a population of nearly 15 million, the forest cover was estimated to be 25% of the area of the country. The Mahaweli Development Scheme, a major irrigation project is to take up around 650,000 acres of forest land in the country. The forest cover plays a vital role in the amelioration of climatic conditions and conservation of soil and water resources. Proper soil conservation measures are not practised in agricultural and tea lands in the hilly areas where cultivation is done up to the river banks. In these areas, when it rains, the rivers coming down the slopes are loaded with silt and erosion is at its worse. Even catchments of the hydro reservoirs are faced with the same problem.

The timber and firewood requirements of the country is another major aspect that has to be considered. The forests in developing countries like Sri Lanka are a major source of fuel. At present the country needs around 30 million cu.ft. timber annually including structural timber, plywood, and poles. The current firewood requirement is around 175 million cu. ft. per annum. Though large part of it comes from agricultural residues, forests contribute a sizeable part of this volume.

To conserve and develop forests in the country, the Forest Department has already launched programmes to set up man-made forest plantations, firewood plantations, agro-forestry, etc. The Department plants between 14 to 18 million trees annually. To date the Forest Department has raised around 370,000 acres of man-made forests in Sri Lanka and these forests produce much needed timber for the country. Strict conservation measures are practised in several Man and Biosphere reserves covering 325,000 acres in different climatic zones. Forest laws have been strengthened and action taken to protect forests in the country from illegal encroachers and illegal timber fellers.

Some strategies drawn up by the Forest Department for continuation and improvement of forestry are:

1. All forests in the country should come within the administration of one authority, namely the Forest Department. At present, forests are controlled and managed by several authorities such as Forest Department, Department of Wildlife Conservation, Government Agents.
2. No land releases should be allowed over an elevation of 5000 ft. (1500 m) above sea level and these areas must be

protected.

3. Continue the reforestation scheme which integrates forestry and agriculture. This will benefit the rural people by providing domestic timber, fuelwood and forage for animals.

4. Reforestation of abandoned chena lands caused by repeated shifting agriculture should be adequately funded.

5. A programme of soil conservation for all degraded agricultural lands should be a strategy with high priority. Such eroded land that has lost its surface soil should be restored to forest cover.

6. Expanded research is required to determine new species for planting both exotic industrial species and indigenous fuelwood species. Leguminous tree species which have rapid growth and relatively dense wood have been selected for the fuel wood plantation.

7. Reafforestation of wildlife lands depleted of vegetation also needs priority. Dual management of certain wildlife lands for both forestry and wildlife is another strategy that should be adopted.

8. A stricter control on felling operations done by the State Timber Corporation in State forests is advocated to prevent over-cutting. Felling by the State Timber Corporation is now done according to the rules drawnup by the Forest Department.

WATER RESOURCES

Available Water Resources

Sri Lanka has average annual rainfall of about 200cm which produces about 100 million acre-feet of water. Of this, about 40 million acre-feet flows through rivers and about 35 million acre feet of water reaches the groundwater basins. But it should be noted that the distribution of rainfall, evaporation, run off and recharge to groundwater basins vary from area to area within the country.

Present Situation

Major part of the surface water is utilized for agricultural purposes. Irrigation department is responsible for the development of water resources for irrigation needs. Between 1979 and 1982 about 60,000 acres under major irrigation schemes were provided with irrigation facilities. In addition, future identified irrigation schemes would supply irrigation water to 27,270 acres of new land.

Also there is development of groundwater for domestic, agricultural and industrial purposes. About 100,000 acres of land is cultivated using shallow tube wells and dug wells from where water is obtained manually by pumps.

A number of water supply schemes have been implemented for utilizing surface water and groundwater for drinking water in towns, rural areas and estates.

For industrial purposes there is about 5 million gallons of water per year used by the private and state organisations. In the industrial zones construction of tube wells to extract about 2 million gallons of groundwater was undertaken.

Ninety percent of the electicity generated in the country is obtained through hydropower. The Electricity Board is responsible for the development of hydropower.

Very limited use of inland waterways is made for transport in this country. A 70 mile long canal from Colombo to Puttalam was used during the colonial period but this needs some improvement for the use again.

There are several freshwater fisheries development projects being operated and constructed by the Ministry of Fisheries. The aim is to increase inland fish production.

Policies and Strategies

1. Protcet all sources of water for efficient and effective allocation, development, utilization, control, conservation and management
2. Coordinate all public waters for potable, domestic, municipal, agricultural, industrial, fisheries, recreational and aesthetic and other uses.
3. Protect water quality. A suitable water resources act may be implemented to prevent people from misusing, under-utilizing and polluting water resources.
4. Necessity to develop programmes of watershed, management to prevent erosion or excessive runoff in forested areas to preserve and control surface or groundwater supplies.

LAND

The total land area of Sri Lanka is about 6.5 million ha (16 million acres). Of this, little more than one quarter is utilized for permanent agriculture, about 25 percent is under forest cover and some of this land is used for shifting cultivation, while over 400,000 hectares are under natural grasslanf and scrubland. Per capita land resources, however, are shrinking rapidly with increasing population and it is estimated that the land will be approximately halved by the end of the century.

The State has always been the biggest single land owner in this country. After the Land Reform Act was implemented, however, it has taken land from private individuals and private companies. Thus, the State is in a position to develop and manage a major part of the country's land resources and to exercise considerable regulatory control over the entire remaining extent.

The responsibility of developing the land resources are carried out by a number of agencies according to priorities and objectives of each agency. This results in little coordination. The environmental impact of these development projects are not always considered. Broad classes under which different uses of land can be grouped are: Urban uses including housing, Mining, Transportation, Tourism, Recreation, Plantation, Irrigated agriculturre, Non-irrigated small scale agriculture, and man made reservoirs and canals. Decisions have to be taken regarding the suitability of land not only among these broad classes but within each class regarding the use e.g. whether to grow rice or sugar cane or cotton on land suited for irrigated agriculture.

Such decisions require background information regarding the soils, climate, vegetation, hydrology and other attributes of land for each projected use. For these purposes an organization with the necessary multi-disciplinary expertise to assess the suitability of land for various potential uses and evaluate the corresponding costs and benefits of each of these uses is absolutely essential. Good landuse planning will ensure only that lands are allocated for appropriate uses. Also continued land use management is essential if the land resource are to be preserved without degradation.

Implementation

In view of the avove stategies the use and management of the land resources of Sri Lanka will require:

1. Adoption of a Land Use Policy.
2. Establishment of an agency, preferably a Land Use Authority that will,
    a. establish a set of landuse guidelines to be followed by all land users.
    b. provide basic informtion on the characteristics of the land resources and its suitability for different uses.
    c. provide assistance in land use planning.
    d. monitor current uses of land with respect to both the appropriateness of use and the hazard of land degradation resulting from poor management.
    e. have power to take action to correct misuses of land referred to in (d) above.
    f. recommend any changes in legislation required to protect the land from degradation and destructive hazards and to preserve it as a renewable resources.
3. Setting up of a high level Inter-Ministerial Committee to coordinate policies and activities among different land using agencies and to ensure that the landuse policies and guidelines are followed.

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SILENT SPRING: IMPLICATIONS FOR THIRD WORLD DEVELOPMENT

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INTRODUCTION

Rachel Carson wrote her famous book. Silent Spring. in 1962 (Carson 1962). The work is now 23 years old and we may ask. Does Silent Spring have relevance for Third World Development today? In this paper. I will argue that Carsons's book has an important message for those who are concerned about the prospects of improving living standards and agricultural productivity in the Third World.

It is important to note that Rachel Carson had already established her reputation as a writer before she finished Silent Spring. She studied at the Pennsylvania State College for Women and earned her Master's degree in Genetics at The John Hopkins University. She taught at Johns Hopkins and the University of Maryland before moving to the Bureau of Fisheries. US Department of the Interior. In 1941 she wrote Under the Sea Wind. and in 1951 she published The Sea Around Us. Her book. The Edge of the Sea. appeared in 1955 (Brooks 1972. p. 24-29). With these three works Carson joined the ranks of Gilbert White. David Thoreau and John Muir. among others. as notable writers of natural history in the English language.

Carson was prompted to write Silent Spring by a letter from Olga O. Huckins. an admirer of her works. who was extremely worried about the heavy use of insecticides for mosquito control in the Northeastern United States (Brooks 1982. p. 203-205). She was particularly concerned that insecticides were being used heavily to control a nuisance and that the damage done by the insecticides was excessive compared to the threat presented by the mosquitoes. The threat. of course was largely a nuisance. not a danger to public health.

Carson accepted the challange of preparing something on the problem. She originally intended to prepare a short article in three to four months. What she actually completed was a book that required four years of extensive work (Brooks 1972. p. 207-214). A perusal of Silent Spring. and the references upon which it is based. make abundantly clear why Carson had to work so long at this project. Problems associated with the use of pesticides are complex on entomological. agricultural. toxicological. environmental and chemical grounds. among others. She delved into the detailed scientific literature in each area in order to argue her case.

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SUMMARY OF SILENT SPRING

The problem Carson addressed in Silent Spring can be understood readily from an important quote that occurs early in the book: "How could intelligent beings seek to control afew unwanted species by a method that contaminated the entire environment and brought the threat of disease and death even to their own kind?" (Carson 1962, p. 8). In this one question, Carson makes it clear that she is dealing with a complex cost-benefit problem. That is, she acknowledged that we face unwanted species, but she goes on to note that the methods by which we deal with them causes harm to the entire environment and even causes a threat of "disease and death" to ourselves.

Early in the book she also gives a quotation that sums up her major argument: "It is not my contention that chemical insecticides must never be used. I do contend that we have put poisonous and biologically potent chemicals indiscriminately into the hands of persons largely or wholely ignorant of their potentials for harm" (Carson 1962, p. 12). Here again we can see the major insights into Carson's argument. She does not believe that all uses of insticide must be banned, an assertion for which she has been blamed. She does however contend that the people to whom the biologically potent compounds are entrusted, are in fact unprepared for their use.

The evidence upon which Carson bases her case is extraodinarily complex. Carson made detailed inquiries into the basic scientific literature relevant to the study of pesticides. At the very least this foray required her to investigate:

- basic chemistry of pesticide molecules
- water contamination
- soil contamination
- aesthetic degradation from herbicide
- death of robins from treatment of elm trees with DDT for Dutch Elm disease
- general bird mortality
- fish mortality
- wildlife damage from efforts to control the gypsy moth in the Northeastern United States, and the fire ant in the Southeastern United States
- contact people have with insecticides through house-hold products and residues in food
- human organismal toxicology
- cellular toxicology
- pesticides as a possible cause of cancer
- destruction of natural enemies by insecticides
- resistance of pest insects to insecticides
- alternatives for pest control other than chemicals.

A brief examination of the extensive literature cited in her references indicates that she studied each of the above problems by detailed inquiry in the scientific literature. Synthesis was her most important achievement, and the effort required a great deal of reading beyond her original training. It is true that Carson did not do original scientific research for Silent Spring, but it is clear that she performed a mammoth and difficult task of synthesizing pieces of evidence from widely scattered sources. It is the scientific triumph of synthesis for which she should be remembered.

IMPACT OF SILENT SPRING

Silent Spring met mixed reviews when it appeared in public. Most reviewers were highly positive, but a few reviews from the scientific community deserve a special notice because of their highly negative viewpoint towards the book. Those few critics who complained about Silent Spring based their objections on three points: (a) the book was unfair to reputable and honorable professionals, (b) Carson had no credentials towork in the field of pesticides and pest control, (c) the book was not balanced in that it did not spell out the benefits from pesticides as well as their detrimental side effects (Darby, 1962: Baldwin, 1962).

It is beyond the scope of this paper to examine these complaints in detail. Suffice it to say that Carson was highly critical of the entomological profession. Many entomologists took offense at her castigation of their scientific work and integrity, but it is important to note that a few entomologists agreed wholeheartedly that their profession had been swept away by the enthusiasm for insecticides (Perkins 1982, p. 32-33). These entomologists felt that Rachel Carson had described the situation quite accurately.

The second point, that Carson had no credentials to deal with pest control science, is a rather vacuous claim, because many people who have become interested in the problems of pest control in fact have not been trained specifically in the science of pest control. In fact, it can be argued that training to be a pest control scientist is inadequate for looking at the entire spectrum of effects caused by pesticides. Carson as a biologist had ample qualifications todeal with this field.

The final point that Carson was unbalanced, is true. She stated explicitly that it was not her intention to cover the benefits created by the use of pesticides because those points had been well covered in other literature. She believed quite strongly that the detrimental effects of pesticides had not been examined thoroughly and it was her intention to devote her attention entirely to this problem.

Scientifically Carson should be credited with a fine job of synthesis. Beyond that she articulated for the first time a comprehensive theory of the ecology of pesticides. Her material indicated that these compounds have great mobility in the environment, affect organisms other than those against which they are directed, create harm or hazards to wildlife and people, and are technologically vulnerable bcause of the fact that they destroy beneficial insects (predatory and parasitic insects) and because pest insects can evolve resistance tothem. Many policy studies have been prepared since Carson's work appeared, and they all come back to these same points. What Carson achieved was the ability to see the entire picture before anyone else had put all the pieces of the pest control problem together.

Her affect on public policy in the United States was not dramatic in the short run. President John Kennedy was aware of the book and directed his President's Science Advisory Committee to prepare a study on the problems enunciated by Carson. Their report, "Use of Pesticides" was issued in 1963, and essentially vindicated Carson's major thesis (President's Science Advisory Committee, 1963). Minor legislation was passed by the Senate.

Carson's ultimate political effect, however, did not come until several years later. In a very way, her attitudes toward nature were a great stimulus for founding the Environmental Protection Agency in the United States. Likewise, the passage of the National Environmental Protection Act and enactment ofthe Federal Environmental Pesticide Control Act were stimulated by the discourse she initiated. Even today in the United States and Europe, Carson's nature philosophy remains a powerful guideline for the environmental political movement that continues.

CARSON, PESTICIDES AND THE THIRD WORLD

It is relatively uncontoversial to argue that Silent Spring had apositive impact in the Western world. As noted above, the effect of her book occurred both in science (the creation of an ecological theory of pesticides) and in political and philosophical values about nature. For persons living in the Third World, however one can raise the legitimate question of whether Carson's work has relevance. Specifically, the need to increase agricultural productivity and the imperative to control public health diseases might lead one to conclude that the needs of the Third World, particularly the tropical countries, are such that insecticides, despite their detrimental effects, are far more valuable and essential than they are in the temperate zones of the industrialized and developed world.

Norman Borlaug argued in this vein in the early 1970's. He made an impassioned plea that DDT and other pesticides were essential for food production in the Third World and that the environmental policies forcing the banning of DDT in the United States were very dangerous for many people living outside that country (Borlaug 1971).

More recently Dr. C. R. Krishna Murti argued that pesticides are an essential part of the strategy for crop protection in India (Krishna Murti and Dikshith 1982). Current low levels of productivity and substantial losses to insects of essential cereals and pulses lend credibility to Krishna Murti's argument.

Critics of strong environmental action to limit the use of insecticides emphasize the benefits of the pesticides rather than their detrimental effects. As noted above, Carson did not cover the benefits and thus one can raise the question of whether she fully understood the use of these compounds in settings other than temperate zone, industrialized countries.

Strong defenders of Rachel Carson can put forth an equally engaging set of arguments about why her book has relevance for Third World countries. First Carson provided a unified ecological theory about the behaviour of pesticides. Although the data upon which she constructed her theory was based entirely on temperate zone climates, it is possible that the theory has validity in the Third World. If it does, then unregulated and heavy uses of pesticides in the Third World may damages there just as they did in the developed countries.

Second, the recent disaster at Bhopal, in which thousands of people were killed and even more thousands injured, raises a question about the total social impact of pesticides. That accident centered on the manufacturing of carbaryl, in which a Union Carbide plant leaked a toxic component involved in the synthesis of the insecticide. The accident was not related directly to the agricultural use of carbaryl, but one must expect accidents in industrial production. Therefore it is possible to argue that the use of pesticides in Third World countries will inevitably be associated with some rate of industrial accident. That situation must also be concluded to hold for the developed countires in which industrial accidents with chemicals like DBCP are now well-known. Seen in this light, the problem is not that an accident happened in Bhopal but that the tragic consequences were too horrendous for any society to bear. Carson's plea for intelligent treatment of these compounds becomes an important message to the inevitable problem of industrial accidents. Most of these accidents, especially the grossly tragic ones, are due to carelessness, stupidity, or incompetence on the part of the manufacturer.

Finally, Carson advanced a strong nature philosophy in which shepictured natural entities as having sacred rights. No reason exists to think that there may not be analagous beliefs in Third World countries. For example, the Jains of India may have feelings about nature that in important ways reflect Carson's views. Science is inevitably affected by such value judgements, and weshould expect the scientists of the Third World tobe influenced by such philosophical assumptions in their society just as Carson was. Many environmental scientists of the Western world have views about the sacred aspects of nature.

DOES CARSON'S ECOLOGICAL THEORY OF PESTICIDES HOLD FOR THE THIRD WORLD?

The first component of Carson's ecological theory of pesticides was the proposition that the action of the chemicals was neither confined to the target species nor to the target area of application. Material cycling is a major component of modern ecosystem theory. The notion that pesticide action is not confined to the place of application is subset of the concept of material cycling in natural systems. The cycling is dueto several factors: mobility through air, water or soil: mobiity through transport by biological organisms: and persistence in both physical and biological media.

We have no reason to doubt that pesticides applied in tropical climates will have mobility through physical and biological mechanisms. The one part of Carson's theory that is in question is the length of persistence of various compounds. Carson based her theory of mobility upon long-term persistence, especially by the chlorinated hydrocarbon insecticides that were widely used during the late 1950s and early 1960s. Since the time of her book many of the chlorinated hydrocarbon insecticides have gone out of use in the temperate zone, and some have gone out of use in tropical areas because of resistance by insects to these compounds. Nevertheless, a question can be raised "whether the persistence of insecticides will be the same in tropical climates as in the temperate climates?"

Dr. Sethunathan and his colleagues at the Central Rice Research Institute, Cuttack (India), have studied persistence of insecticides in the soils of tropical India (Sethunathan et al. 1982). They argue that the conditions of soil moisture, organic matter, redox status, acidity, temperature, sorption-desorption, and mineral constituents all can affect the rates of degradation of pesticides. They advance some speculative reasons about why some compounds may have a higher degradation rate in tropical soils than in temperate soils, specifically DDT, endrin, heptachlor and hexachlorohexane (also called benzene hexachloride).

Given the different physical conditions of tropical environments compared to temperate environments, we should not easily generalize abut the degradation rates of pesticides in different regions. Clearly, Sethunathan's results indicate that degradation rates must be studied as a site-specific problem. It is is found that some of these compounds degrade more rapidly under tropical conditions, then the dangers associated with movement of these compounds away from their target site may be different than the dangers in a temperate zone.

Despite the differences in degradation rate that may be associated with tropical soils, it is clear that insecticides used in tropical environments do have adverse affects on non-target organisms in the tropics. For example, there are many instances of fish kills in rice fields treated with insecticides. Similarly, the work of Dr. John Davies (University of Miami, Florida) indicates that in many tropical areas small growers are particularly at risk in the use of pesticides (UC/AID Pest Management and Related Environmental Protection Project 1976). The reason is that the compounds are frequently distributed in small unmarked containers, such as empty soda bottles that are particularly dangerous because of the likelihood of accidental ingestion. Children are particularly susceptible to such mishaps.

Studies of residues of insecticides in various people indicate that Indians may have 30 times more residues of DDT than is the average in the United States (Krishna Murti & Dikshith 1982). It is a separate question whether the levels of these are an actual or potential hazard, but the higher loads of the compounds in body tissues is a cause for concern.

A second feature of Carson's ecological theory of insecticides was that the compounds applied against a pest insect could equally well destroy natural enemies (parasitic and predatory insects) (Carlson 1962, p. 245-261). The destruction of natural enemies is an unfortunate dissipation ofa major natural resource. It was only with the advent of the synthetic organic insecticides such as DDT, that we began to have experimental proof that many pests are kept under heavy suppression by their natural enemies. Once those natural enemies are killed, the pest insect can frequently rebound quickly to a population size as great or greater than occurred before the insecticide was applied.

A particularly dramatic example of the tragic effects of killing beneficial insects occurred in cotton production in the Canete Valley of Peru in the 1950s. At one point, the yield of cotton fell from 500 kg/ha to 365 kg/ha due to the use of insecticides. Careful investigation showed that the insecticide killed the enemies of Heliothis virescens and Aphis gossypii (Brader 1979). Once unleashed, these isects were devastating to cotton yields.

A second example of the disastrous consequences of destruction of natural enemies has been found in rice prouction in Asia. The rice stem borer (Chilo suppressalis) has frequently been treated with DDT or benzene hexachloride. Unfortunately, these compounds eliminated the natural enemies of the green rice leaf hopper (Nephotettix cincticeps). Destruction of the stem borer has been linked therefore with outbreaks of the green rice leaf hopper (Kiritani 1979).

The final component of Carson's ecological theory of pesticides was that insects can evolve resistance to the very compound that is supposed to kill them (Carson 1962, p. 262-275). Evolution of resistance is a process of natural selection that occurs in a very short period. If a population of a pest is treated over a period of years with a chemical, the individuals that die are most susceptible tothe compound. The individuals that survive and reproduce, tend to be the most resistant. If treatments persist for a long enough period, the only insects left in the field are those that have hereditary tolerance to the material. Resistance when it becomes severe makes a compound obsolete, because it no longer does its intended task- killing the insects.

In 1945, resistance was largely an academic and scientific phenomenon. Thirteen species had by that time been identified as resistant to one compound or another. With the advent of the new insecticides, however, the development of resistance became a more and more common event. By 1960, 137 species were documented as resistant to at least one compound (Perkins 1980, p. 31). By 1970, the total had risen to 224 species. The trend has continued and 428 species are documented in 1980 to be resistant to insecticides (Dover and Croft 1984).

In some cases the resistance has occurred in species that were themselves induced by insecticides through the destruction of natural enemies. For example, the green rice leaf hopper, which is sometimes induced by the destruction of natural enemies caused by insecticides aimed at the rice stem borer, shows resistance to carbamate and organophosphate insecticides of over one hundred-fold (Kiritani 1979).

Similarly, cotton production in Central America has frequently been plagued with resistance problems. In recent years over 20-30 applications per year were applied to cotton in this area, and between 26% and 40% of the production costs of Central American cotton were for insecticides alone. Tragically the heavy use of insecticides in cotton caused Anopheles albimanus to become resistant to insecticides (Brader 1979). Anopheles albimanus is a malarial vector in Central America, and it is a case in which the vector of a public health disease became resistant to chemicals that might otherwise have controlled it because of very heavy applications of those same chemicals against cotton insects. The environmental conditions of a population are surely deteriorated by destruction of the cotton crop, but their environmental health is decreased even faster by an inability to control an important malarial vector.

Worldwide the situation of resistance in Anopheline mosquitoes, which carry malaria, is quite alarming. By 1980, 51 our of 60 species of Anopheline mosquitoes were resistant to one or more compounds. Eighty-four countries now show examples of resistant malaria-bearing mosquitoes (Dover and Croft 1984).

We can now ask the question: Does Rachel Carson's theory of the ecology of pesticides hold for the tropical Third World countries as it does for the industrialized world? Apparently it does. Although a question can legitimately be raised about degradation rates of pesticides in tropical soils, evidence is now abundantly clear that, just as in the industrialized world, pesticies can affect non-target organisms including ourselves, destroy natural enemies to the detriment of agricultural productivity, and public health importance. Much site-specific work remains to be done to understand fully the affects of Carson's theory in tropical areas, but at the moment there seems no reason not to accept for theory of the ecology of pesticides as valid in all areas of the world.

Despite the problems that the use of insecticides are likely to cause in both the developed and the less developed parts of the globe, it is important to remember the benefits these compounds can return. India for example uses an average of 330 g/ha of pesticide in its agricultural production (Krishna Murti and Dikshith 1982). India's rice yields tend to range from 1200-2700 kg/ha. Conversely, Japan uses 1490 g/ha of pesticide in agriculture, and not unexpectedly Japan's rice yields are considerably higher: 5800 kg/ha (Kiritani 1970). Not all of the difference between Indian and Japanese rice yields can be attributed to lack of use of pesticides, but we should not forget that pesticides are one component of high yields in the Japanese agro-ecosystem. Most pest control scientists believe that tropical rice can increase by 1000 kg/ha given the use of modern pesticides.

Another similar example is of cowpeas (Vigna unguiculata). This is an important legume crop in low altitude, warm tropical areas such as Africa, India and Latin America. Cowpeas show spectacular increases in yield when treated with low amounts of insecticides. Similarly, Pigeon peas (Cajanus cajan) can have its yields increase from 400 kg/ha to 2000 kg/ha by judicious use of chemicals. Pigeon peas are important in India and East Africa (Singh and van Emden 1979).

ALTERNATIVES TO THE CHEMICALS

Rachel Carson pointed out in 1962 that many alternatives were being discovered to the indiscriminate use of insecticides for insect control. It is beyond the scope of this paper to trace and describe the many important advances to pest control science that have been made since 1962 (see Perkins 1982, p. 61-126). Suffice it to note that a major advance was development of the concept of integrated pest management (IPM) or integrated pest control (IPC). The Food and Agricultural Organization of the United Nations describes IPC as follows: "Integrated pest control is a pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and method in as compatible a manner as posible and maintains the pest populations at levels below those causing economic injury" (Brader 1979).

It is important tonote that IPM and TPC are based on two important concepts. First, insect pests should be treated if and only if they exceed an economic threshold, i.e., a population level above a minimum and sufficiently high to justify expenditures for pest control technology. Second, both IPM and IPC are based on the notion that natural mortality factors (such as natural enemies and genetic resistance of crop plants) are the core of a sound method of pest control practices. Chemicals may be useful in IPM/IPC strategies, but the core of these technologies lie in the use of resources other than chemicals.

A notable example ofdevelopments on rice in India of IPM/IPC occurs in Orissa on the eastern part of India. Rice in this area is subject to damage from stem borers, gall midges and the brown plant hopper. Better management techniques have been found by using short season varieties,developing strains resistant to gall midges and stem borer, destruction of stubble after harvest, and eliminating use of insecticides during the growth of natural insect enemy populations (Brader 1979).

Evidence is abundantly clear from this and other examples that a highly profitable research line is the development of IPM/IPC for many crops in many areas. Because of the reliance on genetic resistance and natural enemies, this research must be highly site-specific to take account of local soils and local climates.

CARSON'S OMISSION

Rachel Carson, for all the admirable features of her book, omitted any serious discussion of the fact that agriculture in the developed countries has undergone a massive transformation in the first half of the 20th century. This revolution substituted capital, such as machines and chemicals, for human labor. Many farmers were forced out of business during these years, but those remaining in agricultural production enjoyed higher incomes after the change took place.

A major question that scientists and policy makers of the Third World must answer is: to what extent should the Third World countries repeat the technological revolution of agriculture that has already occurred in the developed world? This is a difficult question, because the relationships between capital inputs and demands for human labor in agriculture are in flux. Suffice it to say that careful thought needs to be given to how much labor and how much capital should be utilized in Third World agriculture. The use of improved pest control technology, such as IPM/IPC and peticides, might change the balance between capital and labor, and it would be inadvisable for Third World countries tolet that balance change without developing alternative employment for people leaving agriculture.

CONCLUSIONS

Rachel Carson's book may be 23 years old, yet it contains an important theory that is valid today. Effective and environmentally sound pest control is essential to sustainable development in the Third World. It is only by acknowledging Carson's theory that those sustainable technologies for pest control can be developed.

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ENVIRONMENTAL CONSERVATION IN DEVELOPING COUNTRIES

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DEVELOPING COUNTRIES

The less-affluent countries, many of them recently independent from colonial powers, have been variously called backward, under-developed, undeveloped, less-developed or developing. Two more recent terms in use are 'Third World' and the 'South'. Latin American, African, West, South and South-East Asian countries have been included in the category. The countries have some similarities. The major feature they share is the constraints imposed by the nature of their past and contemporary involvement in the world economy. They are brought together mainly by the relationship they have with the global economy in their depedence on the economic conditions and social and political processes of the First and Second World.

Factors for backwardness

The fact that developing countries lie between the tropics, has led to suggestions that the 'harsh' environment could explain the lack of development. It has been claimed that the 'Third World' is deficient in natural resources necessary to sustain development. A recurrent image of the Developing-countries is of thre 'teeming millions' of people. Could over-population explain their backwardness? Racist arguments suggest that 'natives' are 'inferior' or 'indolent'. Most of the Developing Countries were colonies of Europe: could the explanation be colonial exploitation? It is unlikely that there is any one single factor which can be identified as the cause of poverty. There are many countries, many contrasts, many causes. In recent decades there have been increasing efforts, by both the more developed and the less developed countries, to secure the development of the latter and ease the poverty of the Developing Countries and their people.

Population

There are now more than three billion people in the Developing Countries out of a global population of over 4 billion. This high proportion has come about through persistently high rates of population increase, largely resulting from the decline in death rates accompanied by continuing high birth rates. The population of the Developing Countries as a whole and of most of its parts

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has grown exponentially. Rates of natural increase range, for the most part, between 2.0 and 3.5 percent per annum, at which a population can more than double within the lifetime of a generation. By contrast, in the more-developed parts of the world, population increase in now mostly below one percent per annum. Family planning and control have figured importantly in discussions on population in the Third World in recent decades. Planning and control have often been considered only in terms of limiting or reducing population, whereas they should be seen more objectively as the means whereby the best potential is fulfilled for people both nationally and individually.

AGRICULTURE

Agriculture is the source of food supplies for Developing Countries. In many cases, it also provides the bulk of exports to supprt the external balance of payments and is the source of raw materials for processing and manufacturing sectors. In 1978 about 35 percent of exports (by value) from the developing weorld (excluding China) were of agricultural origin. For most farmers agriculture is part of way of life rather than simply an occupation. It plays a key role in the employment structure where nearly 60 percent of the working population is employed. But agricultural production in many areas of the Third World has failed to keep pace with the growth of population. The food production in the countries is increasing 3 percent per annum, while the demand of food is increasing 6 poercent per annum.

The growth of production of food grains has partly been due to increase in areas cultivated, and partly to a modest increase in yields, but productivity is low compared with that in the advanced industrial world, both in terms of yields per hectare and in terms of labour employed. There are substantial variations within the Third World, both among the major region and within them at the level of individual countries, and it is necessary to look more closely at agricultural production in the context of rural framework and the physical environment of the Third World.

MINING

The Developing Countries are important source of minerals and have about 38% of the world's estimated mineral reserves. However, these are not distributed equally and the area has greater reserves of some minerals than others. It has over half of the known reserves of phosphate, tin, fluorspar, cobalt, copper, tin and nickel. The minerals continue to provide an important potential resource for the Developing Countries, both as a base for industrialization and a source of export earnings. These countries produce one-third of global mineral output, consume less than 10% of the total, and provide half the needs of the capitalist countries. To date exploitation of the minerals of the developing world has been primarily in the interest of the consuming nations of the developed world which do not necessarily accord with the best interests of the producing nations.

ENERGY

Provision of energy is an important factor in the development process. There is a good correlation between levels of energy consumption and economic output, with the industrialized countries having levels of consumption greatly in excess of those of developing world. Reflecting the economic progress of the Third World, its share of world commercial energy consumption rose from 9.5% in 1955 to 20.3% in 1978. The developing world is well endowed with energy sources. Third World countries provide 80% of world energy exports but account for only 25% of the world's consumption. However, the distribution of these reserves is uneven. Reserves of water power are considerable but utilization to date is limited, only an estimated 4% of total available. The possibility exists of developing nuclear power plants in the Third World, by transferring developed world technology.

INDUSTRIALIZATION

For much of the period since 1945, countries of the Third world have given considerable attention to the expansion of manufacturing industry. A crucial poroblem of these countries is the provision of Jobs. The spatial distribution of manufacturing industry in these countries shows a marked degree of concentration at various levels. As a broad generalization Latin America has made most progress in industrialization, Africa the least, with Asia occupying an intermediate position. In terms of employment, Asia has the largest share of the region's industrial workers. The bulk of Latin America's industry is concentrated in some 30 urban-industrial concentrations. The industry developed in the Third World remains restricted in diversity, on relatively small scale, spatially concentrated and of limited significance in global terms. Thus the industrialization has failed to keep pace with population growth and with the concentration of people in the cities. Consequently, the Third World continues to face very high level of unemployment and underemployment.

URBANIZATION

Since the Second World War, urbanization has taken place in the developing world at a pace and on a scale only paralleled by the experience of Western Europe and North America in the nineteenth century. Over 20% people in the Third World live in towns of more than 20,000. Only Latin America closely approaches the level of urbanization in Europe and in North America. Developed world cities and towns confront problems that are more elementary than those experienced by settlements in economically advanced countries. Yet some of the biggest Third World cities have literally the worst of both worlds. Governments have considerable power to influence the urban situation. Encouragement of the positive aspects of squatting by the active planning of site and service schemes could become parrt of an urban strategy for the developing world.

CONCLUSION

Some Developing Countries have already made progress. The special circumstances of the period since 1973 have created the distinctive group of the oil-exporting countries which have massive capital surpluses but also a few other countries have at least progressed up the league table of per-capita income. Between 1960 and 1979 Syria, Hong Kong and Korea each achieved rates of increase in GDP in excess of 9% a year.

One can nevertheless point to some signs of optimism and progress. In much of developing world access to health care and to education has improved: economic structures have diversified: some countries at least have become effective competitors in the world market for manufactured goods. Yet many countries, regions and men, women and children, remain poor, both in relative and absolute terms.

Awareness of the problems of poverty has increased over the past three decades and there is greater concern for securing progress. The Developing World has been persistent in its efforts in this direction. There has been a growing awareness of the potential avaialable for advance in the Developing Countries. One area of particular concern is the formulation and spread of techniques of development that are most appropriate to the needs and endowments of Third World countries. Study of the Geography of any one country of the Third World require more detailed consideration in the context of specific physical, historical, social, economic and political circumstances of the country.

The environmental conservation contribution in the Developing Countries can be made a variety of scales: global, international, national, regional or local. Many of the structural features of the developing world arise from and can be alleviated by international exchange and distribution mechanisms. It would need to be accompanied by changes and initiatives within each country and would require many of the changes and initiatives to be specific to an individual country, or areas within it.

In sum, the developing world offers an opportunity to put conservation techniques to practical use, in the understanding and solution of at least some of the problems of a large part of the earth, and of its population.

GLOBAL ILLEGAL TRADE IN WILDLIFE

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INTRODUCTION

IUCN, WWF, CITES, FOE, TRAFFIC-USA, INSONA, UAN, and many other global NGOs are endeavouring to serve the cause of flora, fauna, and natural ecosystems. However, our own actions must be concentrated on the nine Indian species listed in CITES because they lack protection in their wild state and have already been severely depleted by international trade. These are Fin Whale (*Blalenoptera physalus*), Himalayan Musk-deer (*Moschus moschiferus moschiferus*), Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelya imbricata*), Olive Ridley Turtle (*Dermochelys olivacea*), Saltwater Crocodile (*Crocodylus porosus*), Desert Monitor Lizard (*Varanus griseus*), Yellow Monitor Lizard (*V. flavescens*), and Bengal Monitor Lizard (*V. bengalensis*). The reptiles are highly valued for their shell, skin, meat or oil.

The tip of this iceberg is glimpsed from the seizure from time to time of the skins of endangered species at international airports, and from raids on the shops of furriers.

Among our threatened species is also the Great Indian Rhinoceros (*Rhinoceros unicornis*), whose horn tempts the greedy eyes. A critical watch has also to be kept on the illegal international trade in ivory to save both the Asian (*Elphus maximus*) and African (*Loxodonta africana*) elephants, while the harvests of Bobacts (*Lynx rufus*) within the US, and the export of their pelts has recently become a matter of grave concern for wildlife conservationists. Ultimately, however, public awareness will be an increasingly vital factor in controlling the trade in endangered species (Oza 1980, 1983).

Red Data Books

Red is internationally accepted colour symbolizing danger: this word has been incorporated in the title of the series of loose-leaf books which are compiled and published by the Survival Service Commission (now Species Survival Commission) of the IUCN, the scientific advisers to the WWF. These publications are the result of services rendered by numerous naturalists and conservationists the world over, and serve as major sources for uptodate data on the world's threatened animal and plant species.

These species include those in immediate danger of extinction, those likely to become endangered and, therefore, are vulnerable and those which are rare and in danger.

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Information is put together in the form of short reports, the objective of which is to draw universal attention to the dangers facing these species, and to provide fundamental background as a basis for developing conservation or rehabilitation actions.

Illegal Trade in Wildlife

Several airlines have tightened regulations to ensure humane conditions of transport and safe delivery of live animals, and some nations have begun cooperation, though they have not yet signed the Convention. Nevertheless, as profits continue to decline at an alarming rate, traffickers find the threat of arrest worth the risk. In 1969, in a case in the United States involving 2500 illegal alligator skins valued at more than one million dollars, the ring-leader of the smuggling operation was fined only 10,000 dollars and given four months' imprisonment, but then he had already made a neat 140,000 dollars on sales of the skins earlier.

Let us view a couple of significant instances of illegal trade in wildlife. Excellent pictures from space have made us aware of our planet Earth and we have started learning about the fragility and vulnerability of the natural systems which sustain the human beings. Our only home is under threat as a result of human population explosion. As a consequence, we recklessly consume irreplaceable natural resources.

Threats to wild species of plants have been alarming in recent years for we have depended too much on them for our sustenance and have indulged in indiscriminate trade. Habitats have been shattered and we have plundered rare orchids, butterflies and cacti for collection craze and the sea turtles are slaughtered for their meat and shells.

Seal pups and spotted cats are commercially killed for their skins: rhinos and elephants for their horns and teeth. Such slaughter apparently is unnecessary. But man unfortunately uses his intelligence to profit from such kllings.

ROLE OF CITES

CITES, the Convention on International Trade in Endangered Specis of Wild Fauna and Flora, regulates and controls the multimillion dollar wildlife trade, most of which is illegal. CITES controls import/export on an assessment basis of overall species rarity and consequent vulnerability due to mounting trade. By now, there appears to be a ray of hope for more than 70 nations have adopted the CITES regulations. However, to have its effectiveness more worthy, all the trading nations should be signatories to the convention. Scientists and specialists in the field have put in endeavourr to draft appropriate legislation and even enforcement at the national and international level.

Fate of Tropical Forests

Viewing our tropical forests, scientists are of the opinion that such unique habitats must have been forested for more than 60 million years. Three main areas of the world shelter tropical forests: the giant Amazon and Congo river basins and much of the South-east Asia. Our vandalism has been reponsbile for the destruction of tropical forests. Only about 7% of the earth's land surface has the tropical forest cover. And they sustain possibly 50% of all living species.

Uniqueness of Tropical Forests

The world's rarest animals are to be found only in the tropical forests. Population of tamarins, the attractive primates from South America, has been reduced drastically as a result of hunting, trading and loss of habitat. Tens of hundreds of species are facing the same fate in African and Asian countries. The forest is a home for man's closest living relative- the great apes. The Mountain Gorilla is confined now to just one tiny area of central Africa. Farmlands are trying to engulf it and poachers harass it. The extinction threat continues. But the loss of the tropical forest is just not the loss for wildlife alone. The loss is to be for human beings as well. It is not a question for the denizens of the forest, but for all of us who survive on the multitude of forest products and are at their mercy for our day-to-day existence. We derive edible fruits from numerous forest trees. These are consumed locally and enter into trade globally. We harvest ginger, cola and brazil nuts from the wild. Many of our forest plants have been turned by Man into plantation crops such as tea, cocoa, bananas and pineapples, etc. We grow them on a huge scale the world over. Our demands on the riches of the forests are straight. Modern science and technology development have resulted in ever increasing demand of chipboard and plywood. The Western world is taking a heavy toll of the valuable tropical hardwoods like teak, mahogany, and ebony. British, American, Scandinavian, Dutch and Japanese interests have possessed axing rights over hundreds of sq kms of tropical forests. The developing coutnries rely on short term economic gains based on export of timber logs. Possibly, the poverty comes in their way to turn down lucrative offers.

Apart from timber, tropical forests are responsible to keep the wheels of industry and commerce turning with a steady supply of aromatic and specialised oils, resins, tannins, camphor and gum. And some forest products like rubber have been instrumental in changing the entire course of human development. The modern-day operation theatre is virtualy miles away from a forest clearing. But the tropical forest plants are a vital source for tubocurarine and atropine without which the latest surgical techniques will be impossible. Our fight against the cancer threat is based on drugs extracted from forest plants. For new discoveries we have to be dependent on our forests. Do not foreget that millions of our native people depend entirely for their basic necessities on tropical forests.

The Plight of the Tiger

Initially for the 'Operation Tiger' eleven tiger reserves were founded in the Indian sub-continent. Nepal; Bangladesh, Bhutan, Indonesia and Thailand desired to protect their remaining tigers and WWF supported their conservation actions. When our earlier generations flourished, the tiger's habitat extended right across Asia. Eight sub-species of tiger were recorded. But the present tiger survival story is sad. The earlier range of the tiger covered vast tracts of Indian forests. Today it is met within the Himalayan foot hills, central and southern Indian broken hilly and plateau countryside and Sunderban forests. In early 20th century, the tiger's survival status was never doubted for there existed around 40,000 animals. However, the year 1969 put the Indian tiger count less than 2000. The IUCN Red Data Book has accorded a red sheet for the endangered tiger. Ironically enough, the tiger's skin attracted human vision and the greedy Man accounted for its decline.

WWF and several conservation organisations convinced women as to how embarassing it looks to appear in public clad in furs of tigers, leopards, cheetahs, jaguars and ocelots. In the early eventies, the International Fur Trades Federation was persuaded to give up trading in skins of tigers, the rarest cloded leopards and the snow leopards. A legal ban was imposed also in 1970 on killing tigers and trading its skin in and out of the country. There are now strong controls in the trading of all striped and spotted cat skins, a wide range of other animal and plant species and their products. However, poachers and skin traders earn fantastically in the world markets. And tigers are poisoned with controversial agricultural pesticides. Thus, the animals must be dying in agony for tigers are trapped cruelly and starved and meet with premature death to satisfy the vanity of favoured few.

In spite of the scientific management plans put into action, the situation for the tiger is delicate and dangerous in Palamau (Bihar), Manas (Assam), Simlipal (Orissa), Corbett (U.P.), Ranthambore (Rajasthan), Kanha (M.P.), Melghat (Maharashtra), Bandipur (Mysore) and Sunderbans (W. Bengal). This is due to the destruction of the thorny, dry or moist deciduous or semi-evergreen forest cover and grasslands. The surviving populations are too scattered to maintain viable breeding populations for the future.

Illegal Trade in Birds of Prey

Global illegal trade has threatened with extinction the birds of prey like eagles, falcons, ospreys, buzzards, kites, vultures and condors. To add to their plight, the egg collection and the loss of feeding and nesting areas figure prominently. Pesticides enter their food chain causing damaging effects to their fertility potential, thinning of egg shells, malformed young and ultimately dashing them to death.

Commercial Slaughter of Turtles, Crocodiles, Babyseals

Marine turtles face commercial slaughter for their meat, shell or oil and their eggs are plundred when whales arrive ashore for breeding. We take life out of crocodiles to turn them into handbags. Baby seals are bludgoeoned to tailor fur-coats for humans. Numerous sea turtles have been swimming in the Indian and Pacific oceans for more than a hundred million years. They are found in the tropical Atlantic as well. The Olive ridleys while nesting have adorned our beaches. But we have made inroads on their marine habitats. Future survival of the sea turtles is jeopardized. In the Caribbean, turtles are gharpooned. Modern pressures on the turtle hunting have caused collapse in their populations. But with this the integral part of the culture of the Miskito Indians of coastal Nicaragua is shattered. There does not exist any bony link between top and bottom shells of sea turtles. The West Africans cut off the belly shell or plastron at the sides, carve out meat in pieces for stewing or broiling. Turtles end up in pots. People of Micronesian islands remove their intestines through incision near the tail, else the entire animal is roasted over fire. The eggs of the group-nesting Olive Ridley turtles are harvested so intensively and extensively that hardly a single nest survives. The Carib Indians in Surinam are engaged in egg collection close to the ocean. Turtle eggs have flourishing markets in tropical countries for their supposed aphrodisiac values and fetch money more handsomely than the hen's eggs. Prolonged boiling does not harden the white of the eggs. The flexible shell is tore apart and the eggs are eaten raw with spices lending a touch of taste and flavour. Hawksbill is one of the most endangered species of sea turtles today for its commercial demand of 'tortoise shell' and the entire stuffed juveniles enter illegally the US and Japanese markets. In the absence of the hawksbill, young green turtles become the targets of souvenir manufacturers who capture them before they reproduce and are done to death to cater tothe needs of thoughtless tourism. Sea turtles such as these Olive Ridleys no longer be molested by Man on their rightful remote beaches. If Man becomes a casual visitor to their fantastic abodes, future generations shall be lucky to share the wonderful world for reciprocal benefits.

Demand of Rhino Horn

The world's five species of rhino in Africa, India, Java and Sumatra are in grave danger of extinction, by poachers, for they take a heavy toll to flood the Far East places with rhino honrs to satisfy the aphrodisiac ethics, proved scientifically most untrue. Rhino horns reach Yemen to turn into decorative dagger handles. The one-horned rhinoceros earlier ranged from the Indus valley to northern Burma.Their present home is in Brahmaputra valley in Assam, two small reserves in West Bengal and in the Chitwan Valley in Nepal terai. They enjoy legal protection for their conservation in Assam's Kaziranga National Park and in Nepal's Royal Chitwan National Park. The great one-horned rhino weighing 2 tons, is 6 feet shoulder high and 12 feet in length. Its thick studded skin folds have a close parallel to joints in mediaeval armoury. The rhino horn is upto 2 feet long growing from the skin of the nose. Poaching which aided in the decline of rhinos has been reduced in recent years. But Rhino viewing in the Kaziranga is a good foreign exchange earner through planned tourism.

Illegal Trade in Ivory

Ivory has lucrative illegal trade. WWF has extended its support to curb poaching activities. Earlier, the elephant existed from the Tigris and Euphrates in the west through Asia south of Himalayas to China in the east. Pakistan and countries to her west have lost entirely the elephant. This means, it is now restricted to hilly and mountainous regions where the modern Man desires to initiate development activities and alienate his life from the elephant. It is shocking to note the exclusion of the elephant from the fertile accessible floodplains of giant rivers such as the Indus, Ganges, Irrawady, Mekong, and Yangtse Kiang. Now these very regions sustain some of the heaviet human population pressures in the world, where the early human civilizations established a close relationship with the elephant. This is reflected in our religion, culture, and architcture. But the latest situation is that how many of us have seen an elephant in the wild? Their numbers in the wild have declined drastically. Elephant tusks are instrumental in having with us beautiful ivory artistic works. African elephants have been poached for tusks for the Asian ivory trade. The ivory trade needs a watch for the survival of the African and Asian elephants. But the habitat destruction poses one of the greatest threats to the surviving Asian elephant populations. The advancement of technology to take care in settling human population is very evident. With the loss of large tracts, the elephants are deprived fo of their preferred food plants. Consequently, they invade crop lands and Man views them as pests. We are facing acute problems of feeding millions of our hungry people. People cannot tolerate seasonal migrating elephants in search of food outside the national parks. The original wooded home of the elephants in N.W. India not far from the Indus river wears a semi-desertic look. Cattle grazing pressures and fuel demand have taken a heavy toll of the forests. The area neither shelters elephants nor fairly sustains human beings. When we have the invasion by elephants in our crop plantations, it is an indicator of the degradation of our forests.

Other Threatened Unique Wildlife

Let us have a look at the sorry state of affairs with other wildlife. The baby gibbons are captured for the pet trade after shooting their mothers. Beautiful butterflies are caught and killed to be framed as souvenirs for money. Commercial slaughter of our unique wildlife still continues. Instead we should derive pleasure from nature by observing our wildlife in their homes, National Parks. Tourism can be a potential earner of the much needed foreign exchange. The Raja Brooke Birdwing, the black and green butterfly in the Malaysian forest is threatened as a result of overcollection. Would it not be disgraceful for us to lose such beautiful insects?

We should not forget that our dependence is based on the natural systems and our very survival and prosperity shall be possible in our harmonius dealings with Nature. This educative message has to reach our younger generations to have a feel of belonging to our planet Earth. We have only one home to dwell in and it is our obligation to preserve it for our own well-being.

Dr. J.R. Vallentyne, one of the crusaders for the World Campaign for the Biosphere, and INSONA have launched already a crusade to 'Save Our Biosphere': 'Conserve Today, Save Tomorrow' is our slogan for the well-being of the Earth and its dwellers (Oza 1983).

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DEVELOPMENT AND ENVIRONMENTAL STRATEGIES

C.K. Mishra*

PRESENT MODEL OF DEVELOPMENT

The term development is so mcuh in use that I am not supposed to tell the definiton of this word. Every one, be it a society, region, state or nation is trying hard to develop i.e., the type of development achieved by the so-called developed countries. We are trying to imitate the developed countries. In this aspiration of ours in achieving the western models of development characterized by excessive use of materials and machines we have been importing all sorts of western technology. The economists have invented the concept of GNP for ascertaining the stages of development. The higher the GNP of a country or a society, more advanced it is supposed to be. I feel that you all are aware of the fact that for achieving the highr GNP we are required to consume and produce more materials and services per capita. That is the GNP is directly linked with the rate of consumption of our resources.

The fact with regard to GNP is that it is a rather erroneous concept in estimating the developmental status of the country because from a given higher GNP we cannot judge many things: for example, GNP does not indicate the status of health of the population or the present position of the existing resources and also it does not tell the future status of the country.

A number of economic models of development have been worked out by various schools. I will not go into the details of these models. But what I could gather from the type of western model being aspired and followed by various countries is based on the excessive use of non-renewable resources which is characterised by the production of wastes which cannot be recycled.

Now I would like to briefly mention about the environment and the position and role of men in the environmental system.

ENVIRONMENT

There are many definitions of "environment". Mishra (1978) considers environment as a composite term for the conditions in which organism lives. It includes both biotic and abiotic substances, energy and forces e.g. temperature, light, water, air, soil and other orgnisms. The environment is divisible into outer

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environment external to the body and internal environment as the conditions within the body. The other definition (Shukla 1985) mentions that "Environment is the totality of all social, biological and physical or chemical factors, individually as well as collectively that compose the natural and man-made surroundings".

Man is a part of environmental system, not away from the system. So far man has been interfering with the environment in order to achieve the so-called development of economists. The need of the hour is to evolve an environmental strategy: we should consider all aspects of the environmental system- structural, functional and evolutionary.

In order to operate any system there are certain basic principles- the various components by way of feedback mechanisms should remain in homeostasis with regard to material cycle and energy flow.

About Biome

Misra (1983) observed the importance of organisms in building our life support system has already been emphasised. Our global heritage, the biosphere holds with us approximately 1840.9 x 10^9 tons of (dry) phytommass (Leith and Whitaker 1975) and 2.0 x 10^5 tons of zoomass (Whittaker and Likens 1973) besides 0.05 x 10^9 tons of domestic animals. The total number of known aspcies living with us is approx. 5 lacs of plants and 10 lacs of animals including microbes (Misra 1981). It is estimated that about 9 million species of plants and animals became extinct during evolution but the simultaneous emergence of more species which are extent with us has maintained this higher figure during the holocene period. However, the rate of extinction of plant and animal species recently accelerated on account of industrial activities. About 10% of the plant species are disappearing each decade on account of destruction, waste and misuse of the vegetation, and thousands of species are threatened by early extinction.

Since man is an integral part of the environmental system, his existence also depends on the existence of all the species of fauna and flora.

ENVIRONMENTAL PROBLEMS AND HUMAN EXISTENCE

In his book "Statistical and Mathematical Aspects of Pollution Problems", Pratt (1974) describes that most of the current activity in the field of environmental control is national in character. Efforts to deal with man's impact on the environment and the repercussions on a world-wide scale or uneven and uncoordinated concern with these problems seems to depend on population density, degree of industrialization, consumption of products by urban societies, intensity of agriculture, and living standards, public education and environmental awareness. According to him

"Environmental variables" are:

A. physical and chemical data from the atmosphere pertinent to climate-change potential,
B. Physical and chemical data from air, water, soils and biota pertinent to human health and welfare:
   i. physical, chemcial and biological data reflecting the state of human health,
   ii. biological data reflecting the performance of biological system.

According to him "Environmental problems" are:
   i. potentially adverse climatic change resulting from human activities,
   ii. potentially advaerse changes in biota and man from contamination by toxic substances including radionuclides,
   iii. potentially adverse changes in biological productivity caused by improper landuse (reduced soil fertility, soil erosion, extension of arid zones, etc.).

Neglect of Environmental Problems

In his article "Bhopal Gas tragedy: Has it opened our eyes?" Rathore (1985) describes the callous indeference to reports on pollution danger did not surprise me at all. I have been drawing attention to many environmentally dangerous situation obtaining in this state. The environmental situation at Singrauli in relation to the proposed Sanjay Nagar Township, which would be literally sandwiched btween the most potent environmenal polluters, coal-mines and super-thermal power stations, is one of them. Amlai Paper Factory effluent discharged in Sone river is another such example. During summers this factory diverts the entire river through itself to meet its water needs what flows down is not Sone but a river of pure effluents. The situation is alarming because of a dam being constructed downstream which will perhaps collect all this and distribute it as irrigational water to far-off places. The entire area between Maihar and Katni is one big gas chamber. We have created Department of Environment, Environmental Planning and Coordination Organisations, Pollution Prevention Boards and passed Environmental Policies, Water and Air Pollution Acts which only create the illusion of an environmentally responsible administration. The system, by and large, continues to remain insensitive and pays only lip service through countless seminars and workshops and waits - should we saw for such tragedies to occur. Bhopal Gas tragedy is the tip of an iceberg. Environmental disaster is much more enormous and the issues are much more grave.

Further Rathore (1985) has pointed out that the situation is all the more disgusting because Madhya Pradesh was emerging as a leader in the area of environment. Earlier, its present political leadership exhibited a great sensitivity towards environmental problems. The state passed its own environmental policy. It has created its own department of housing and environment. It has its own pollution prevention Board. It has created another organisation named environmental planning and coordination oranisation or EPCO. Are they just frills and show pieces? About EPCO, he says, this body is still in search of its identity and role visualized as to work, as the most potent and apex environmental organ of the state, this organisation is in shambles and is managed by fly-by-night experts.

Consequently, further he points out that the State's Pollution Prevention Board presents another dismal picture. It has a facade of poorly equipped laboratories which are totally incompetent to monitor air and water pollution integrally and effectively. The Board management follows the corrupt practices of periodic inspection instead of round the year monitoring at key points. Pollution is not merely a chemical or environmental engineering problem. It is a predominantly ecological problem and its integral vision includes the futuristic projections in terms of backlashes and complications due to food-chain networks.

It is clear that all bodies related to environmental aspects must have only environmental experts, not non-environmental discipline candidates.

Future Model of Development Based on Environmental Thinking

The problems noted above require more concerned and concerted efforts in order to ensure that we hand over a comparatively better environment to future generations. Some suggestions are made below to this end:.

Ennvironmental education must be imparted to all persons. Besides other environmental activities it is necessary to implement developmental model based on renewable resources and recycling of wastes. To achieve this I suggest a provision be made for the following officials to look after environmental matters:

1. Block level - Senior Technical Assistant (for information and sample collection).
2. Tehsil level - Assistant Environmental Officer
3. District level- Environmental Officer or Deputy Director of Environment (for work coordination).
4. Divisional Environmental Officer or Joint Director Environment. The office must have a well equipped laboratory.
5. State capitals-
   Joint Director of Environment (Industries and Mining)
   Joint Director of Environment (Water Bodies)
   Joint Director of Environment (Agriculture and Soil)
   Joint Director of Environment (Energy)

Joint Director of Environment (Forest and Wildlife).
One Director of Environment

Experts from different environmental fields may also be involved at each level.

The work of these set-ups will include:

- Monitoring and management of the resources.
- To assess the pattern of environmental utilization for government and public life.
- To assess the interaction between rich and poor people for environmental utilization.
- To assess the Environmental Impact Assessment of local, regional and state level.
- To assess the effect of all new programmes on environment.
- Control of environmental activities related to all departments, either governmental and non-governmental.
- To check anti-conservational activities.

National policy of development as an integrated environmental strategy based on renewable resources is essential. An integrated strategy for judicious environmental utilization in each environmental system will help incorrect development.

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NEED FOR TRAINING AND EXTENSION CENTRES/INSTITUTES FOR ENVIRONMENTAL STUDIES AT STATE LEVELS

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There is now a global as well as local concern about the deteriorating quality of environment and rapid depletion of natural resources. The need for environmental pollution control and balanced use of resources is not confined to industrial countries alone. The ecological impacts of irrigation schemes, use of fertilisers and pesticides, deforestation followed by soil erosion are felt everywhere in rural areas and they affect the backward section of the society the most. Thus there is an increasing need today to generate awareness about pollution control, ecological management, forest and soil conservation, wild life preservation, recycling of municipal and industrial wastes, etc. amongst teachers, engineers, scientists, planners and administrators to broaden and intensify their expertise to analyze and solve environmental problems. There is also equal necessity to generate environmental consciousness amongst the rural masses and the illiterate and the poorer section of the society.

In view of the above objectives it is proposed that Centres of Environmental Studies, Training and Extension be established at state levels as well as at the national level.

AIMS AND OBJECTIVES OF THE CENTRES

The main objectives of the centres will be as follows:

i. To advise the Government and its agencies on environmental issues of public interest and to assist them in the formulation and implementation of state environmental policies and conservation strategies.
ii. To liase and offer consultancy services to industries and other agencies on environmental matters.
iii. To impart regular and fulltime education on environmental science by running postgraduate courses on the subject.
iv. To impart nonformal and continuing education on various aspects of environment to government officers, planners, teachers, scientists and engineers through short-term training programmes and workshops.
v. To conduct research on environmental problems by itself and those sponsored by the industries and other agencies.
vi. To monitor and sponsor research programmes related to environmental studies on behalf of the Government.

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vii. To monitor water and air qualities of industrial locations on behalf of the Pollution Control Boards.

viii. To organise, sponsor and support seminars, symposia and conferences from time to time where various experts in the universities, scientific institutions, government departments and autonomous institutions can meet, discuss and analyze environmental problems of the country or the concerned states.

ix. To assist the state as well as the central governments to generate public awareness about environment amongst the masses through mass communication methods.

Site and Construction of the Integrated Environmental Complex

About 50 acres of land will be sufficient for a full-fledged complex. It should be preferably near a freshwater body or a forest land which can be used for research purposes. The main structures in the complex would include administrative buildings, class rooms and laboratories for teaching, research and training, library, hostels, staff quarters, guest house, workshops, demonstration biogas plants, solar energy conversion units, wind mill, eco-garden etc.

Administrative Structure of the Centre

The centre will be supported by the State Government in the Department of Science, Technology and Environment (for regional centre), Government of India in the Department of Environment, Department of Non-conventional Energy Sources, Department of Science and Technology, University Grants Commission and other national and international co-ordinating agencies. Each will be headed by a Director. The teaching and training programmes will be co-ordinated by the Dean of Studies. The various teaching and training departments will be as follows: Environmental chemistry, Environmental health and microbiology, Environmental management & social engineering, Environmental biology and forestry, Energy studies and rural technology, Applied earth science and meteorology, Environmental engineering, Environmental extension.

Training and Teaching Programmes of the Centre

The teaching and training programmes will consist of course work for Ph.D., M.Phil. and M.Sc. degrees in Environmental Sciences, short-term training in specialised branches, refresher courses, workshops, conferences, demonstration eco-camps. Most of the candidates taking part in course works, training programmes etc. will be sponsored by industries, government departments and other agencies who will meet substantial running costs of the teaching and training programmes.

Research, Consultancy and Linkage with Professional World

Research will be an important part of the distinctive academic activity of the centres. Interdisciplinary research will be encouraged. The participation of students, faculty, industries and other agencies will ensure team effort towards problem-solving activities, mission-oriented and nationally-relevant research.

The number of research students (M. Phil., Ph.D. and post-doctoral) to be admitted will be restricted depending upon the number of identified problems and collaborations with fellowships offered by various agencies and organisations.

Ph.D programmes may operate within the campus or outside in industrial or other environment affected area. However, some theory and practical courses will be offered at the centre as pre-requisite for research.

The thrust areas of research may be identified from time to time. Initially they may be (a) study of air and watrer quality at industrial and high population density locations, (b) deforestation and its influence on climate and soil, (c) soil erosion study around major deforested and hydro-project areas, (d) alternate energy asources for rural population, and (e) study of eco-consciousness in rural and tribal areas, etc.

The centres will also offer consultancy services to various industries (in R & D work and pollution control), agencies and the Government in environmental matters.

Keeping linkage with professional bodies, they will have collaborative education/research/training courses throughout the state (for regional centres) or the country (for national level centre). Research grants offered by the Government to scientific personnel outside the centres can be routed through them for effective monitoring and control.

Since most of the research will be sponsored by industries and other agencies, the financial burden for this will not be heavy.

Generation of Environmental Consciousness Amongst the Masses

Generation of environmental consciousness amongst the masses will be an important activity of the centres. It can be done in various ways, e.g.,

i. by publishing popular articles in newspapers, periodicals, booklets, propaganda leaflets, etc. on environment,
ii. by promoting or sponsoring such literature by persons not belonging to the centre,
iii. by promoting folk literature and other folk activities on the subject through award of grants and other incentives,
iv. by awarding persons for slogans, drawings, cartoons etc.,

v. by awarding persons annually for useful activity towards environmental protection,

vi. by promoting and aiding nature lovers' clubs in schools, colleges etc.,

vii. by preparing film strips on environment.

viii. by organising short-term orientation and motivation courses for youths through governmental & non-governmental organisations like Nehru Yuvak Kendras, N.S.S. units of educational institutions, Rotary Clubs etc.

The Department of Environmental Extension will organise the above activities with the help of the other departments of the centres.

PESTICIDE POISONING AND TREATMENT

M. Kamel*

PESTICIDE POISONING

Pesticide poisoning is an emergency. Hence, it should be recognized early and first aid procedure and definitive treatment should be given promptly and properly.

The importance of early recognition of this illness cannot be overemphasized since non-recognition of mild symptoms can end up in disastrous severe manifestations resulting in death.

First aid procedure administered as soon as the illness is recognized may spell out the big difference between saving or losing the patient.

Signs and Symptoms of Poisoning

- Headache
- Nausea
- Gastric distress
- Restlessness
- Hot feeling
- Flushed skin
- Sweating
- Deep and fast breathing
- Fast beating of heart
- Fever
- Ashan color
- Collapse
- Coma

Severe poisoning usually runs a rapid course. One usually dies or is almost well within 24 to 48 hours.

Recognition of Pesticide Poisoning

Recognition or arriving at a correct diagnosis of pesticide poisoning can be achieved by the following:

1. Clinical diagnosis: based on a history of pesticide exposure and the appearance of signs and symptoms compatible with time dose relationship.

2. Laboratory confirmation, e.g. cholinesterase determination, pesticide and/or metabolite studies in the blood and urine and intact pesticide studies.

Pesticides belonging to a chemical grouping cause similar signs and symptoms which may be mild, moderate or severe, depending upon the pesticide and the amount absorbed. Having some of the signs and symptoms does not always mean that there is poisoning. Other kinds of sickness may cause similar manifestations. Headache and feeling of being unwell, for example may signal the

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Dept of Medicine, Al Azhar University, Cairo, Egypt start of many kinds of illness. It is the pattern of the manifestations that makes it possible to tell one kind of sickness from another.

Three Levels of Exposure to Pesticides

Pesticide poisoning may occur at three levels of exposure:

1. Acute exposure - acute poisoning resulting in systemic poisoning. local injury or combined systemic and local poisoning following accidental or intentional single acute exposure (Suicide).
2. Chronic high exposure - endangers exposed individuals to long term adverse effects or chronic toxicity of pesticides such as in the occupationally exposed workers.
3. Chronic low exposure/ incidental exposure of the general public, due mostly to pesticide residues which may induce directly or indirectly conditions favourable for development of cancer and other diseases.

CLASSIFICATION OF PESTICIDES

A. Based on Level of Hazard

WHO classification of pesticides by hazards:

	LD50, mg/kg			
	Extremely hazardous	Highly hazardous	Moderately hazardous	Slightly hazardous
Oral:				
Solids	50	5- 50	50- 500	500
Liquids	20	20-500	200-2000	2000
Dermal:				
Solids	10	10-100	100-1000	1000
Liquids	40	40-400	400-4000	4000

B. Insecticide Classification

I. According to the Way They Affect Insects

1. Stomach - toxic quantities are ingested by the insect.
2. Contact - kills upon contact with an external portion of the body.
3. Systemic - capable of being absorbed into the plant system where they make plant parts insecticidal.
4. Others (replellent, fumigant, etc.)

II. According to Chemical Nature
   1. Organochlorines
   2. Organophosphates
   3. Carbamates
   4. Pyrethroids
   5. Biological/microbial
   6. Botanicals
   7. Others (repellent, fumigant)

C. Herbicide Classification

   1. Formulation
   2. Selectivity: selective or non-selective.
   3. Mode of action: contact, translocated or systemic.
   4. Time of application: preplant, pre-emergence or post-emergence.
   5. Chemical Nature
      - Phenoxy compounds (2,4-D)
      - Substituted amines (Machets)
      - Thiocarbamates (Eptam)
      - Substituted urea (diuran)
      - Bipyridilliums (paraquat)
      - Triazines (Atrazine)
      - Others

D. Rodenticides

   a. Anticoagulant- inhibits prothrombin and causes capillary damage. Symptoms include bleeding from the nose, gums, gastro-intestinal and urinary tracts, hematoma, anemia.
   b. Acute rodenticide- produces varied acute manifestations depending upon the active ingredients.

E. Bipyridyls (paraquat and diquat)- produce proliferative changes in a variety of tissues.

Skin exposure- irritation, discoloration and irregularity of finger nails.

Eye exposure- conjunctivitis and keratitis.

Inhalation- irritation of nose and throat, sometimes with nose bleeding.

Oral ingestion- oral, substernal and abdominal pain, vomiting and diarrhoea, muscle aching, oliguria, jaundice, cough, dyspnea, tachypnea, pulmonary edema.

The lung complications usually progress to death.

F. Miscellaneous pesticides (pesticides of plant origin, biologicals, fungicides, etc.)- Produce varied manifestations depending upon the composition of the formulation.

Generally, these pesticides have low order toxicity.

FIRST AID PROCEDURES

First aid is the initial effort to help a victim while medical help is on way. The first step you should take in any poisoning emergency, except when you are alone with the victim, is to call for a physician and/or an ambulance or any vehicle to carry the patient to the nearest hospical or clinic. If you are alone with the victim, see to it that he has an adequate pulse, is breathing regularly and that no further exposure occurs.

While you are waiting for the doctor and/or vehicle to arrive, do the following emergency management:

A. Removal of the Poison

I. For swallowed poisons:

1. Empty the stomach: should be done anytime within 3 hr after ingestion and perhaps even longer if large amounts of absorbents were given promptly.

   1.1. Induction of emesis (vomiting): The most important choice you must make when aiding a person who has swallowed a pesticide is whether you should make the victim vomit The decision must be made quickly and accurately: the victim's life may depend on it. Usually, it is best to get rid of the swallowed poison fast before it gets absorbed. However, there are contraindications:

   - Never induce vomiting if the victim is drowsy, unconscious or in convulsions. It may cause death.
   - Never induce vomiting if the victim has swallowed a corrosive poison. A corrosive poison will burn the throat and mouth as severely coming up as it did going down. There are strong acids or alkalis such as dinoseb and the victim will complain of severe pain and have signs and symptoms of mouth and throat burns.
   - Never induce vomiting if the person has swallowed petroleum products (kerosene, gasoline, lighter fluid, oil). Most pesticides that come in liquid formulations are dissolved in petroleum product. The words "emulsifiable concentrate" or "solution" on the pesticide lables are signals NOT to induce vomiting in the poison victim if he has swallowed the concentrate. If the victim has swallowed a diluted form of these products, however, he should be forced to vomit immediately.
   - Also, do not induce vomiting in patients with cardiac disease, aneurysm and females who are in their third trimester of pregnancy.

Mechanical stimulation of the pharynx (Gagging) can remove 50% of stomach contents. Ipecac syrup can remove 90-100% of stomach contents. The dose is 10-15 ml for children and 20-25 ml for adults. A second dose may be given if emesis does not occur within 15-30 min. Ipecac is cardiotoxic and more than two doses should not be administered. Fluid extract of Ipecac is about 14 times more concentrated than the syrup: hence, its use must be avoided.
1.2. Gastric lavage can remove 75% of stomach contents. This will be done in the clinic or hospital.

The use of salt (NaCl) as an emetic in poisonings should be discouraged because serious salt poisoning may occur from deliberate ingestion in unsuccessful attempts to induce vomiting.

2. Limit the Gastro-intestinal Absorption

2.1. Activated charcoal- this is an odorless, tasteless fine black powder, the residue from destructive distillation of various organic materials e.g. wood pulp, suitably treated to increase its absorptive powder. When administered in an adequate dose, this absorbent inhibits gastrointestinal absorption of a broad spectrum of chemical compounds. Its dose is 30 g in 1/4 glass of water as a slurry, then induce vomiting. This should be administered preferably within 30 minutes after ingestion of the poison.

2.2. Household remedies, if activated charcoal is not available, include:
a. Beaten egg white for all types of poisons (upto 8 eggs for adults, and 4 eggs for children):
b. Milk for acid or alkaline pesticides (1 to 2 glasses for victims under 5 years, and 2 to 4 glasses for those over 5 years).

II. For Inhaled Poisons

If poisoning is by inhalation, remove the patient from the area of exposure and remove all contaminated clothing. Almost all toxic pesticides can be absorbed not only by oral intake but also by inhalation and through the intact skin. Clothing serves as reservoir for dermal absorption and inhalation of pesticides. Remove materials on the skin by rinsing with copious amounts of running water. Soaping followed by copious rinsing will remove a greater amount of poison. Never apply oil on the contaminated skin since this may facilitate or increeae poison absorption. Keep the patient comfortable by covering with a loose cotton blanket.

III. For Eye Contamination

In case of eye contamination, flush the eye immediately with running water for several minutes. Because of pain and spasm, assist the victim by holding his eye-lids open and allow gentle stream of tap water to irrigate all the surfaces. In attending to the victim, avoid being contaminated with the poison while treating him.

B. Maintenance of Breathing

To assure free and patient airway, observe the following measures sequentially:

1. Position the patient on his side (if poison has been swallowed, turn him toward the left side to prevent further tran-sit of stomach content into the duodenum where greater absorption can occur) with the head extended and lower than the stomach level by 15 to 30°. Maintain this position while patient is in transit.
2. Remove any secretion from the mouth and throat by careful suctioning. Do not attempt to do mouth to mouth resuscitation, especially if poison has been inhaled or swallowed.
3. In an unconscious patient, make sure that the tongue is held forward by inserting a small hard blunt object (back of spoon or tongue depressor, preferably an oropharyngeal airway tube) between the tongue and palate.

If facilities are available, do an endotracheal intubation and administer oxygen.

Since pesticide poisoning requires hospital care, the victim should be brought immediately to a hospital equipped to manage poisoning cases.

ANTIDOTES

Antidotes are substances which remove or prevent the absorption of a poison, change its toxic properties or counteract its physiologic effects. Different types of antidotes are:

1. Mechanical- removes a poison or prevents its absorption e.g. Emesis, gastric lavage, surface washing, cathartics, activated charcoal.
2. Chemical- acts chemically to form a non-toxic or less toxic compound by forming an insoluble product or by oxidation.
3. Physiologic- action is opposite to that of the poison, e.g. atropine for organophosphates.
4. Pharmacologic- highly specific system antidotes which are efficient in blocking the actions or effects of poison, e.g. pralidoxime for organophosphates.

Kinds of antidotes for pesticide poisoning

Antidote	Poison	Remarks
1. Activated charcoal Dose: Child- 10-20 g in 100 ml water, orally; Adult- 30 to 50 g in 150 ml water, orally.	Effective for all poisons except cyanide, alcohol and iron.	No reaction except staining
2. Atropine sulfate Dose: 0.015-0.05 mg/kg. Child- 1 mg i.v. Adult: 2-3 mg i.v. Repeat every 5-15 minutes until mus. effects disappear, increasing intervals	Organophosphate carbamate.	Atropinization is achieved if the following are present: pupil 4mm, heart rate 120-140 per min., dryness of mucous membranes
3a. Pralidoxime chloride 1 g in 20 ml sterile water, i.v. after 1 hr symptoms improve; may be repeated for total dose of 300 mg/kg in 48 hrs.	Organophosphate	Contraindicated in carbamate poisoning
b. Obidoxime Dose: 3-6 mg/kg i.v.		
c. Diacetylamonxima Dose: 1-2 g i.v.		
4. Vitamin K1 (phytonadione, "Aquamephyton"). Dose: 10-150 mg by slow i.v. the first day.	Coremarin derivatives. Warfarin Rat poison oral anticoagulates	Monitor prothrombin time to guide therapy. Fresh blood transfusion may be needed.

POISONING WITH ORGANOPHOSPHATES AND CARBAMATES

Organophosphates and carbamates pose the greatest health problems among pesticides because of their extensive use in agriculture. These chemicals produce adverse effects by their powerful inhibitory action on the enzyme cholinesterase producing a rise in the amount of acetylcholine, a neuro-humoral chemical transmitter. Acetylcholine is liberated at nerve junctions and acts on receptors by: (a) Producing contraction of the smooth muscles of the respiratory, gastrointestinal and genitourinary tracts: (b) secretion of exocrine glands (lacrymal, salivary, bronchial, gastric and sweat glands): (c) depressing the rate and force of cardiac contraction and vasodilation: (d) causing skeletal muscle paralysis as a result of persistent depolarization: and (e) stimulating and depressing the central nervous system.

Mild poisoning with cholinesterase inhibitors may be manifested as headache, fatigue, dizziness, blurred vision, excessive sweating nausea and vomiting, stomach cramps, diarrhoea and salivation. These symptoms can be seen in illness not related to pesticide poisoning such as influenza, gastroenteritis and heat exhaustion.

Moderately, severe poisoning can produce all symptoms of mild poisoning such as chest pain, wheezing, inability to walk, muscle twitching, and show pinpoint pupils. The physician may misdiagnose the patient as having myocardial infarction, asthama, pneumonia, or encephalitis.

Severe poisoning usually results in loss of consciousness, local or generalized convulsions, and worsening of symptoms which are seen in moderate poisoning. The patient may be mistakenly diagnosed as suffering from cerebrovascular accident.

Treatment of organophosphate and carbamate poisoning is mainly directed towards the establishment and maintenance of patent airway, including artificial respiration when needed, and administration of antidotal therapy.

Atropine (sulfate and other salts): blocks the action of acetylcholine in the muscarin receptor sites and all smooth muscles) and the central nervous system.

If the patient is not cyanotic, atropine is injected intravenously at a dose of 1 to 4 mg every five to ten minutes until signs of atropine given by intramuscular route to avoid venticular fibrillations: only after cyanosis has been relieved can atropine be given intravenously. Atropinization should be maintained 24 to 72 hr or even more by parenteral administration: the interval and dose depends on severity of poisoning and monitored on an individual basis. There is a high degree of tolerance for atropine in organophosphate and carbamate poisoning. Majority of cases are inadequately treated (under atropinized) resulting in recurrence of symptoms and even death. Atropine may be given by the oral route once the patient is fully conscious and continued for several days for as long as signs and symptoms of poisoning persist.

Atropine dosage in children is 0.03 mg/kg body weight per dose. Exchange transfusion may be life saving in severe organophosphate/carbamate poisoning in children.

Oximes may be helpful in severe organophosphate poisoning but are contraindicated in carbamate toxicity. If oximes are used, they must be given early enough, to assure that they are rich phosphorylated cholinesterases while the phosphate-enzyme bond can still be cleaved to regenerate cholinesterase.

Pralidoxime, obidoxime and diacetylmonoxime are given intravenously and are effective to relieve skeletal muscle paralysis induced by organophosphates. Diacetyl monoxime is the most potent in reactivating brain cholinesterase. Oximes are not effective when given alone: concurrent atropine therapy is necessary. Other therapeutic measures should include:

a. Correction of fluid-electrolyte imbalance including the metabolic acidosis with sodium bicarbonate.

b. Treatment of convulsions with diazepam or diphenylhydantoin.

c. Attendance to concomittant cerebral edema and cardiovascular complications.

d. Good nursing care.

The following drugs are absolutely contraindicated in organophosphate and carbamate poisoning: opiates, xanthines such as aminophylline, phenothiazines, reserpine, tranquilizers and succinylcholine. Furosemide may be administered if indicated occurrence of hypokalemia or low serum potassium must be avoided.

Organophosphate/carbamate poisoning can be diagnosed by determination of cholinesterases, urinary metabolites, and intact pesticides.

Red cell cholinesterase activity correlates well with nervous system cholinesterase activity whose depression is usually parallel to severity of poisoning in its initial stages. A depression of 25% or more is strong evidence of excessive organophosphate/carbamate absorption. In cases of suspected poisoning, value of 9.5 ph/hour or less (Michel method) of red cell cholinesterase represents abnormal depression or probable poisoning. Plasma cholinesterase levels may be depressed in conditions other than pesticide poisoning such as liver disease, malnutrition, hyperplasia, myocardial infarction, dermatomyositis, after certain drugs (procaine, neostigmine, etc.) and in individuals with genetically low plasma cholinesterase. Low red cell cholinesterase may be depressed in severe anemia and in rare conditions such as paroxysmal hemoglobinuria and disseminated sclerosis.

Chronic exposure to organophosphates and carbamates can lead to significant depression of red cell and brain cholinesterases that signs and symptoms of intoxication occur. The victims should be treated as in acute poisoning and prevented from further exposure to anticholinesterases until cholinesterase levels have returned to normal values. Investigators have also found a significant increase in the incidence of leucopenia and neurologic signs (loss of reflexes, tremor, ataxia) among workers exposed to organophosphates than the control population. Reversible but persistent neuropsychiatric changes have also been reported in people chronically exposed to parathion.

ORGANOCHLORIDES POISONING

Poisoning with organochlorine pesticides happens through accidental or intentional ingestion, inhalation, or percutaneous absorption. The exact mechanism of action by which toxicity in man is produced by the organochlorines has not been fully identified; however, the main manifestation could be attributed to predominance of sympathetic tone and central nervous system stimulation.

Symptoms of acute poisoning include parathesis, excitement, giddiness and fatigue, tremors, convulsion and coma. Nausea and vomiting are prominent when the chemical is ingested. Pulmonary edema is common. Respiration may be stimulated initially and later depressed. Signs and symptoms of toxicity are usually aggravated by the effects of petroleum solvent.

Early symptoms of chronic poisoning are headache, loss of appetite, muscular weakness, fine tremors, and apprehension. Liver degeneration with hematological changes such as anemia, leucocytosis and kidney damage may occur. Complete recovery is usual if the patient avoids further contact with the chemical as soon as the condition is diagnosed.

Severity, onset and persistence of toxic effects vary with different chlorinated insecticides depending on such factors as persistence after application, rates of such absorption, storage in body tissues and metabolism.

Management of poisoning is mainly symptomatic. Since convulsions and respiratory pathology both lead to anoxia and death, the control of convulsions and treatmnet of pulmonary edema are of paramount importance. Airway clearance and oxygenation can be attained by early intubation in moderate to severe cases of poisoning. Intravenous furosemide may be administered for pulmonary edema. Barbiturates or diazepam by intravenous route can control convulsion. Phenytoin helps prevent not only convulsions but also cardiac arrhythmias which occur frequently since these chemicals sensitize the myocardium to endogenous epinephrine and norepinephrine. Intravenous mannitol or dexamethasone may be necessary in patients with cerebral edema.

If the poison is ingested, saline cathartics may be given after lavage and activated charcoal administration. Oils, milk, cream and other substances containing vegetable or animal fat should be avoided since these products enhance absorption of organochlorines. Among contraindicated drugs are epinephrine and other adrenergic agents.

A high caloric low fat diet has been reported to improve the recovery of patient from organochlorine poisoning.

DIPYRIDYL POISONING

Paraquat and diquat produce local injury to the skin, nails, eyes, mucosa of mouth, respiratory and gastro-intestinal tracts. Paraquat in concentrated solutions may casuse inflammation, necrosis of skin and mucosal linings, shedding of nails and delayed healing of cuts and wounds. Inhalation of dust or spray may cause nasal bleeding. It is very toxic when digested. After oral intake gastrointestinal symptoms such as nausea, vomiting and abdominal cramps are prominent. The second phase occurs four to five days later with liver and renal pathology; the patient develops jaundice and anuria. Should the patients survive these phases, pulmonary proliferative changes occur until he succumbs to respiratory failure. Those who survive should have careful pulmonary followup as long as six months after poisoning.

Contaminated skin and eyes must be irrigated for 10 to 15 minutes with copious amounts of water. An opthalmologist should be consulted for any eye contamination. Ingestion of dipyridyls should be treated immediately and vigorously to limit absorption by doing a lavage with seven percent sodium bicarbonate and giving effective adsorbents and 30 percent suspension of Fuller's earth. Excretion is facilitated by giving sodium sulfate one hour after the adsorbents and induction of forced diuresis with either mannitol or furosemide. In severe cases, peritoneal dialysis or hemadialysis may be life saving.

Corticosteroids and expectorants like ammonium chloride and potassium iodide may be of therapeutic value in minimizing pulmonary damage.

NITRO AND CHLOROPHENOLS POISONING

Dinitro-orthocresol, pentachlorophenol and dinitrobutyphenol are used as insecticide sprays fungicides and wood preservatives. They are potent metabolic stimulators by the uncoupling of cellular oxidative phosphorylation.

The main manifestations of poisoning are high fever, rapid breathing, fast heart rate, cyanosis and muscle cramps. Death from respiratory and circulatory collapse occurs within 24 hours.

Therapy is mainly directed at preventing body heat accumulation with the use of hydrotherapy (cold packs, ice enemas), adequate fluid replacements and chloropromazine. Antipyretic drugs are not useful and may do more harm. Oxygen therapy is a must. Artificial respiration may be life-saving. If ingestion is the route of poisoning, five percent sodium bicarbonate lavage should be done followed by saline cathartisis. Prevention of kidney and liver damage should be instituted early. Hemodialysis is of questionable value due to high degree of plasma protein binding of these sustances.

ANTICOAGULANT RODENTICIDE POISONING

The hydroxycoumarine and various acyl and aryl indandiones kill rodents by inhibiting prothrombin formation and directly injuring blood vessels resulting in hemorrhage. Poisoning may occur through a large single oral intake or repeated oral ingestion or percutaneous exposure. There is a latency of several days before symptoms of poisoning are seen.

The antidote for anticoagulant rodenticides is vitamin K. The aqueous vitamin K (phytonadione) is preferred, given subcutaneously or intramuscularly in 10-25 mg doses, intravenous route may be required in severe bleeding.

Fresh whole blood transfusion is valuable in severe poisoning to supply accessory coagulation factors. Vitamin C (100 mg several times a day) may be useful adjust in therapy. Secondary iron deficiency anemia may be treated with oral ferrous sulphate.

ENVIRONMENTAL INTERPRETATION

Dhun Karkaria*

The people who visit national parks. monuments. a zoo or an area of outstanding natural interest form a very select part of the population. These are people who are already motivated to an extent of making the decision to visit such a place. It would be too much to say that their primary interest is on environment or culture or that they have come to learn something. In many cases the visit may merely be a picnic or an outing. At times. the person may not have made the decision at all, but his accompanying another person who has persuaded him or her to join in the trip. All the same. the 15000 people who visit the Kanha National Park each year or for that matter the 1.3 million people who visit the Delhi Zoo have some more motivation than the average person in India.

The places they visit also offer an incredible opportunity for education. Here we are not dealing with the model or a chart or some other form of representation of a reality. but are in the midst of reality itself. But the experience of a visitor standing in front of the Taj Mahal can never be compared with that of seeing the best photograph or a scale model in a museum. It is at this vital moment when you have a motivated visitor and the real object in front. whether it be a monument, a tree, a mountain or an animal that is an ideal time to learn something interested about what he sees. This is the moment when the person is interested and wants to know more. He may wish to know something about the history of the place, may want to know the behaviour of some animals. he may wish to know something about the context or even a structural detail. If the right information is given at this right moment it would be the ideal form of environment education. This form of environment education is commonly refered to as interpretation which will be the focus of my comments today.

The Centre for Environment Education at Ahmedabad is today involved in two major interpretive programmes at the Kanha National Park in Madhya Pradesh and the National Zoological Park at Delhi. We were also engaged earlier in a variety of interpretive programmes including an exhibition and a booklet on Gir National Park. a map on wildlife sanctuaries of Gujarat, educational package for visitors to the Bandhipur Tiger Reserve, educational folder on several tiger reserves and an educational pamphlet used at wetland habitat. We also collaborated with the National Museum

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Centre for Environment Education, Ahmedabad 54, India of Natural History, New Delhi, to prepare interpretive material like take-home labels, and a workbook that can be used at the Museum. Today I will draw on experiences of one of our projects, viz. Interpretive Programme for Delhi Zoo to discuss the theme.

Interpretation can be considered a communication link between the visitor and his experience. Interpretation is an educational activity which aims at giving meaning and understanding to what is seen. The first-hand experience is enhanced by illustrative and audiovisual media. The aim is not to communicate factual information but rather highten the quality of the observation. It tries to create a sensitivity in the visitor towards the beauty, complexity, variety, and inter-relatedness of the environment; a sense of wonder; a desire to know and a better perception.

In general, interpretation seeks to achieve three objects. The primary objective is to assist the visitor in developing a keener awareness, appreciation, and understanding and to make the visit a rich and enjoyable experience. Interpretation also tries to accomplish management goals. For instance, in case of the zoo, the programme would have to educate people in terms of correct behaviour as to minimise the damage that visitation does today. Finally, interpretation also seeks to make people aware of the larger goals of a programme. The role of zoos in the larger conservation strategy of the country has to be communicated.

Over a million people visit the National Zoological Park, Delhi each year. While on a working day there would be 2000 to 3000 visitors, the maximum rush is on the Republic Day, when the numbers can reach a high 50000 visitors. The cross section of visitors is equally varied- urban, rural, young, old, illiterate, literate, small and large groups, disciplined, and vandals. The Zoo covering an area of 214 acres has 1600 animals and is served by 275 staff members. People visit the zoo to see the animals. A visit to the zoo is an activity people look upon as fun, as an excursion and sometimes even as a picnic outing. Schools, do not look upon their visit as a lesson in ecology or conservation.

It is in this context that the interpretive programme has to be designed in order to help people understand the purpose of the zoos, its role in conservation research and the propagation of endangered species. The main interpretive theme, conservation, has to be dealt with implicitly rather than explicitly. At no stage should the visitor get the feeling that he is being given an unwanted dose of conservation messages or formal education. The creative ability of the interpretation team must be directed towards creating an awareness of the role of the zoo in conservation without making it too obvious to the visitors.

People visit the zoo to see live animals. They do not come to sea exhibitions. In a zoo situation as far as possible interpretation must be done in conjunction with direct animal viewing experience. Outdoors rather than indoors, media that can be used along with viewing must be the primary ones. Wayside exhibits, carry-with-you materials and the zoo education assistants become primary tools of the park's interpretive programme.

The visitor centre at the zoo does, however, have an important role to play. Viewing animals in enclosures at best can only be a limited experience. The movement of animals, their sounds in the wild and their textures cannot be experienced. With imaginatively planned exhibits, the visitor centre can fulfil this need.

The conservation theme needs to be treated implicitly rather than explicitly. Through the wayside exhibits, the film at the visitor centre, and the handbook, we would like to develop the conservation message. Behind-the-scenes story would be best handled through a short film which could be titled "A day at the zoo". This could be shown continuously so that most visitors get a chance to see it. A special outdoor display where enclosure design techniques can be displayed using actual artefacts and tools used to keep animals successfully is proposed. This could be developed in one of the empty enclosures and people allowed to walk in. The role of the visitor centre exhibits would be to compliment through interactive exhibits the animal viewing situation. Wayside exhibits will be the primary media at the zoo. The usual approach of providing standardised information on animals is for this reason not adequate. Wayside exhibits will focus attention of the visitor on specific animal characteristics or behaviour. At times it will have to relate a success story. Wayside exhibits will sometimes need to relate the animal with its natural habitat.

A children's workbook has been proposed as carry with you material that would enhance the educational quality of the viewing situation. The educational component will be handled in a way that at no stage do the children feel that they are being taught a lesson.

Sensitivity to animals cannot be instructed but needs to be inculcated. A children's zoo area where children are allowed to approach animals at close quarters would be ideally suited for this purpose. In this area of the zoo children could feed animals and pet them. This type of area has elsewhere been very successful in inculcating sensitivity to animals and would also be an introduction to how animals are kept in captivity.

School children form a large part of the zoo visitors. As most of them come on organised school trips, we feel that special programmes aimed at these target groups could be organised. In addition to a discovery room, an interactive approach has been adopted for all the exhibits at the visitor centre. The discovery activities will be designed in kits which schools could borrow. There will be an introductory guided tour for schools. In addition, several special tours with guides and appropriate media are proposed. For example, a trip to the zoo on the theme of African animals could be accompanied by seeing a special film on their habitat. Special worksheets and activities based around the African themes could be developed.

In addition to the general film "A day at the Zoo", we are also recommending a film on the role of the National Zoological Park in conservation that would stress the success stories and a third film wwhich would show many of the zoo animals in their wild habitats. An audiovisual has been proposed to show through slides animals in reference to their habitats. This could be two screen- slide presentation, and done imaginatively with school children being the target goup.

The first phase of the programme that I have talked about will be tried towards the end of this year. This will give us a lot of experience and feedback, and we hope to receive comments from many of you to improve the quality of the interpretation.

ENVIRONMENTAL EDUCATION IN THE KODAIKANAL INTERNATIONAL SCHOOL

C. Karunakaran*

GENERAL FEATURES

Kodaikanal, famous holiday resort, a heaven for peaceful settlement and location for educational and research institutions of quality, has risen to fame and popularity mainly for following reasons:

a) A bracing, cool climate with little change in temperature throughout the year due to its high altitude and geographic location.

b) Its scenic splendour with rugged mountains, deep valleys and waterfalls.

c) Its green cover of natural vegetation and introduced species of trees, shrubs and grasses. Some of these flowering trees are of extraordinary interest, such as Rhododendron arboreum and Magnolia grandiflora which occur indigenously here but have their natural habitat predominantly in the Himalayas. These along with a few animals like the Thar indicate climate changes in India during the past ten thousand or so years following the retreat of the last Ice Age.

d) A plentiful rainfall spread almost evenly throughout the year derived from both the southwest and northeast monsoons which help in maintaining the incomparable greenery of Kodaikanal.

e) The creation of an artificial lake about a century ago by Sie Vere Henry Levinge, the Irish Baronet, and Collector of this District, by a cleverly constructed rock fill arch dam at the neck of an incomplete ring of hills.

This lake is the most beautiful and attractive aspect of Kodaikanal providing recreational facilities and water for human consumption.

f) Reasonably good access from the plains by two 'ghat' roads, from Madurai and Palani.

In order to maintain and improve the quality of life in Kodaikanal, it is important to pay attention to and take steps for the preservation of above mentioned features which have made Kodaikanal world famous for its educational and research centres and as a beautiful place for rest and recreation.

The history of Kodaikanal, particularly of the past two decades, shows that there has been serious deterioration in

International School, Kodaikanal, India several priceless characteristics of this hill resort, due to unwise human activities. If allowed to continue, it could seriously damage the fragile ecosystem of the Kodaikanal area, to the extent that it may be difficult to retrieve the position and recapture or recreate the original beauty and usefulness of the area.

ENVIRONMENTAL DEGRADATION

Some examples of environmental pollution and deterioration which have been identified, based upon the studies carried out in the Environmental Sciences Division in the Kodaikanal International School, are given below.

It is well known that vegetation has a positive contributary effect on climate. Deforestation may cause reduction in rainfall, while removal of the vegetation cover, particularly on the steep slopes characteristic of the area would definitely cause severe soil erosion. Removal of soil which is practically irreplaceable, would prevent further growth of vegetation and will start the vicious cycle towards desertification. Several examples of severe soil erosion as result of human activities were studied in this school, particularly in tracts where terrace cultivation is practiced. Where such cultivation is attempted on slopes steeper than the critical angle of stability, the entire terraced structure slides down causing extensive and irrevocable damage and substantial losses.

There has been extensive tree cutting in and around Kodaikanal in recent years to the extent that old residents state that the face of Kodaikanal has changed and its beauty deteriorated.

Monoculture

There has been considerable controversy regarding the introduction of foreign tree species into the Kodaikanal area, mainly Eucalyptus (*E. globulus* and *E. giganticus*), Pine and Wattle (*Acacia*). All are economically important providing fuel, fibre to industry, oil and other chemicals. They are also attractive in appearance and are to be seen in and around Kodaikanal as giant stands of timber which form a tourist attraction, particularly the one in Bryant's Park which deserves special mention. From the above it can be seen that that the most important factor in environmental protection in this area is planting trees. In the choice of trees to be planted, several aspects can be considered, from the point of view of beauty and elegance of fruit trees, flowering trees, the economically important timber trees and the indigenous vegetation of the area known as shola forest.

Shola Forest

As mentioned earlier, Kodaikanal is famous as the natural habitat of two attractive flowering trees, namely, *Rhododendron arboreum* and *Magnolia grandiflora* besides the Himalayan Cherry (*Prunus puddors*), Nepal oak (*Quercus incana*) and many others which are indigenous in the Himalayas and which along with a few other animals like the Thar or mountain goat and other mammals, represent the climatic changes in the Indian subcontinent following the last Ice age. While these trees are to be seen sparsely distributed in the forests or private gardens, they are conspicuous by their absense around the lake or along the main avenues. Other attractive tres which need attention are Eucylyptus (E. fissifolia and E. citridora) with its clusters of orange coloured blossoms and several trees and shrubs. These thrive in the shola forests in the valleys but are being replaced rapidly by the economically important varieties of Eucalyptus and wattle.

It is highly important to preserve the shola forests which included several fruit trees support a variety of life especially bird life, on these hills.

Simultaneously with the planting of trees and equal importance to their proper nurturing, special attention must be given to the protection and improvement of the lake and its environs.

Kodai Lake

Since the lake has been artificially created, it has an unusual and attractive scallopped, four petal shape caused by water backing up into the main and tributary valleys of the original river systems. The lake is bordered all around by fairly steep slopes upto the crest of the ridges surrounding the lake.

The slopes are occupied by residential buildings, schools, hotels, plantations, farms, a park and a few acres of mixed forests of indigenous and exotic vegetation.

The lake waters have definitely deteriorated during the past few years. From being potable and popularly used for swimming in until a few years ago, specially by the Kodai School students and staff and holiday makers, the water on recent chemical and biological tests recently, has been shown to contain deadly bacteria and viruses.

Periodical analysis of the lake water conducted in the Environmental Sciences division in the Kodaikanal school, has identified locations of influx of polluting wastes into the lake. The School has also identified major areas of pollution and other aspects of environmental deterioration in and around the Kodai lake area during the course of studies last year. These are:

a) Entry of partially treated and untreated sewage consisting of facal wastes, food wastes, detergents and various decomposed material at several points.

b) Silting of the marginal zones of the lake, particularly in the sectors where the valleys of the old stream are located. This phenomenon, known as eutrophication, can progressively diminish area and the volume of its water.

c) Influx of pesticides and fertilisers from the farms and orchards on the slopes, by progressive run off during and after rains. These are particularly located along the south-western sector of the lake.

d) The toe of the slope, that is its lowest part, is extensively cut into or excavated by human agencies, so that in many parts, it is either vertical or overhanging. This leads to instability of the slope, endangering the stands of timber above, choking the drainage and also posing a threat from land slips, to the lake read itself.

e) Garbage generated around the lake is swept into the lake. This consists of horse dung which is a carrier of deadly tetanus and other germs, food wastes from the lake club restaurant and litter left by picinckers around the lake. At present in the absence of large rubbish bins, the people get encouraged to dump their wastes into the lake.

The latrines provided around the lake have drains guiding the effluents into the lake.

f) Washing of vehicles has become a common practice for residents/institutions/and the business community, at the lake margins. This deposits oil and other wastes which are not biodegradable, directly into the lake water.

g) Vehicles travelling at high speed along the lake road pose a hazard especially to children enjoying their recreation around the lake.

Natural Marshes Around the Lake

On account of the fact that the lake has been formed by damming a river with three tributaries into which the waters have backed up partially filling them, several marsh land tracts of great natural beauty occur around the lake. These support a characteristic vegetation with a variety of wild flowers and habitat for many forms of animal and bird life. Among these wild boar and porcupine are worth special mention.

These minor ecosystems are precious aspects of the Kodai lake area and must be preserved in their a pristine state. But already there are alarming signs of deterioration in these micro environments which are fragile in character. Domestic wastes flow through them; some have been partially drained and converted for other purposes.

The Township

Away from the valley which holds the lake and separated from it on the east by a ridge, lies the township of Kodaikanal with the satellite towns Moonjikal and Nayudupuram, and some villages.

With the rapid increase in tourism and the growth of several new institutions including a factory, population of the townships has increased very rapidly bringing with it all well known problems of rapid, unplanned urban growth. Choked sewage systems, scattering of rubbish in areas where drains do not exist, appearance of liquor shops in areas visited by ladies, deterioration of roads unable to bear the highly increased traffic under the old maintenance programmes, inadequate supply of safe potable water, shortage of fuel etc., are some of the problems that appear to be steadily mounting.

Among the ominous signs was a dreadful proposal to meet the imaginary problem of public transport by creating a bus terminal in the Burton compound well away from the township. This spot just west of the lake is at present a beautifully wooded spot.

This proposal was wisely vetoed by the District Collector, an action quite worthy of her illustrious predecessor who had created the lake itself about a century ago.

Comments

The above brief narrative of the urgent environmental problems besetting Kodaikanal and growing at an accelerated pace, highlights the urgency for creating a Master Plan for the preservation of Kodaikanal as a beautiful place for study and recreation. It is also necessary to achieve this objective, to consider the posting of carefully selected officials and inclusion of prominent citizens, possessed of the necessary awareness of environmental awareness and wisdom to deal with the problems peculiar to this rare hill resort.

ROLE OF KODAIKANAL SCHOOL IN PROTECTING THE ENVIRONMENT

This High School is perhaps the first school in India to introduce a full-fledged course on Environmental Science with a component for practical field studies, including field sampling and chemical analyses, terrain evaluation, map reading, field mapping, planting trees and so on. This has already attracted the favourable attention of the Minister for Environment, Govt., of India.

The School has besides, a few other relevant courses such as on Science, Technology and Social Change, Geography and on Social Sciences. Also some pioneering studies had been carried out on the use of solar energy in water heating to supplement use of conventional fuels.

The Kodaikanal School possesses the necessary expertise and is actually carrying out studies relevent to environment in the following specific areas, as a continuing programme: Systematic sampling and rapid determination of acidity of water to locate points of pollution.

This will be supplemented by the following studies when suitable equipment is available:

Determination of B.O.D., dissolved oxygen, nitrate-N and phosphate content, Light penetration in water using the Secchi disc. This is a direct indicator of organic content, Lake bottom sampling and analysis, Slope analysing according to international practice; Terrain evaluation using aerial photographs in stereo pairs and stereoscope, large scale topographic maps to periodically assess changes in cultural patterns and land use; Preparation of large scale maps of selected areas to record and interpret points of environmental pollution; Soil analysis according to U.S. Dept.-of Agriculture standards; Systematic classification of flora and fauna including wild plants and animal life; Management of nurseries for plants and tree planting as a continuing programme: Study of urbanisation and rural development in selected areas.

ENGINEERING EDUCATION FOR ECODEVELOPMENT OF HILL AREAS

S. B. Synghal and Vijay Raj *

INTRODUCTION

Most of the hills of our country especially the Himalaya are geologically young and unstable. Major activities in hill areas are based on the natural resources such as forests, mineral and water resources, agriculture, horticulture, animal husbandry and wild plant and animal life. In addition many developmental activities, such as construction of roads, multipurpose river valley projects, mining, industry, tourism, etc. which are taking place at an accelerated pace, are resulting in considerable damage to the fragile hill ecosystem.

The combined impact of the above mentioned activities has resulted in serious disturbances to the existing hydrological, sedimentary and material cycles, as well as flow of energy in the system. These disturbances not only affect adversely the people living in the hills, but also those living in the plains, through devastating floods, siltation of reservoirs, rivers, ports, etc., and prolonged droughts in many areas. Thus, the ecodevelopment of hill areas is important not only for the people living in hills but also those living in the plains.

PROBLEMS OF HILL AREAS

The topographical, geophysical, climatic as well as ecological characteristics of hill areas are remarkably different from those of the plains. The land available for agriculture is limited, the irrigation, transport and communication facilities are inadequate, their maintenance is costly, availability of storage and marketing facilities is poor. In addition, one has to encounter problems associated with rugged and undulating terrain, high altitude, low temperature, rarified atmosphere and high intensity short duration rainfall. As a result, the problems pertaining to resource development, transportation, human settlements, agriculture, irrigation, energy and power encountered in hills also differ markedly from those of the plains.

Another striking feature of hill areas is the distribution of population, which is usually thin and scattered, but the density of population/unit of cultivated area is far higher compared to that in plains. The socio-economic conditions and life styles of hilly people are also different.

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The low population density, coupled with the topographical and other factors mentioned above, increases the cost of infrastructure development and hence the provision of essential services, amenities and commodities link roads, electric and water supply, transport of goods and people, become more expensive as well as difficult.

NEED FOR REORIENTATION OF EDUCATION

To achieve the aim of a sustainable eco-development of hill areas, a more specialized knowledge and understanding of above referred problems is necessary. The various personnel engaged in development of hill areas must have a sound knowledge of hill ecology and environment, so that these form the basis of the planning, design, construction and maintenane of development activities in hill areas, as otherwise we may find to our disappointment that negative aspects of developmental activities may soon become predominant, and retard or even reverse the pace of development.

In fact 'one problem, one solution' approach will fail to make the desired impact and may even, at times, create many new and more serious problems. The region has to be visualized as an ecosystem, and developmental activities in various interconnected areas have to be taken up simultaneously to achieve the desired goal of sustainable development. It is essential from this point of view, that engineering education is so reoriented that the entire development process is conceived of as an integrated system with a number of interacting subsystems. The management of all the available resources should be taken up simultaneously based on the integrated systems approach, and through it optimal benefits to the target people be made available.

SUGGESTED REORIENTATION

Since the very concept of eco-development is to be based on principles of ecology and environment, it would be essential to keep hill ecology and environment as the core of such a course.

The main thrust areas to be included in the study are water, land, plant, energy and mineral resources development, hill transportation, hill settlements and municipal services. Other associated thrust areas of importance are hill surveying and remote sensing, geology and geo-technic, disaster management etc.

Water resources management should include hill irrigation, water harvesting, catchment area development, control of floods and flash floods, multipurpose river valley projects etc.

Land resources development would include landuse planning, watershed management, erosion and sediment control, rehabilitation of mining areas, regeneration of endangered areas effected by erosion caused by faulty agricultural practices.

Plant resources development should include enhancement of agricultural productivity, conservation of germplasm of endemic flora, indentification of species suitable for afforestation, local herbal medicines, grassland and pasture development, agro- and plant based industries, and improvements in silviculture.

Energy resoiurce devaelopment would include renewable and nonconventional resources of energy (wind, gyser, biogas, solar etc.), micro and mini hydel power schemes, improved methods of combustion, power projects, etc.

Mineral resource development would include survey of mineral resources, their conservation, regeneration, optimal utilization and mineral based industries with suitable emphasis on the resettlement of areas degraded through mining activities.

Hill transportation includes its planning for the region to cover hill railways, highways, aerial ropeways, cableways, etc. In addition it would include design, construction and maintenance of hill roads, ecological aspects of highway planning, utilization of local materials (timber for bridges etc.) Stability of slopes, airstrips and helipads inland, water transport etc.

Hill settlements would include planning of settlements, utilization of locally available building materials like stone, timber, bamboos, habitat planning for earthquakes and flash floods, low cost houses, water supply and sanitation for hill regions, power distribution for hill settlements and rural electrification.

Among the associated areas, hill surveyiang and remote sensing should include geological, hydrological and topographical studies through aerial surveying, remote sensing and photointerpretation methods.

Applied geology should include geology of hill ranges, tunnelling methods, geological aspects of multipurpose projects, highways, seismic studies, geological considerations for fixing alignments of communication systems.

Disaster management would include causes, consequences and mitigation of natural disasters (like landslides, earthquakes, flashfloods, avalanches, snow blizards, glacial flow studies), contigency planning concept, disaster prevention techniques, vulnerabilaity analysis, etc.

THE FIRST STEP

As a first step in this direction, a Post-graduate course entitled 'Hill Area Development Engineering' has been introduced at M.M. Malaviya Engineering College, Gorakhpur. The course covering the above noted thrust areas, is designed to impart specialized training to Civil Engineering Graduates.

This, however, is only the beginning. We have to recognize the development of hill areas as a separate discipline for the purpose of study, wherein all activities taking place in hilly areas are considered in an integrated manner.

The scope of Engineering education will have to be widened to cover topics like the development of post-harvest technology, packing processes, horticulture, agriculture, tourism, marketing management, mineral resources development, animal husbandary, pollution free industries, meteorological studies tribal studies, etc.

SUGGESTIONS FOR FUTURE EDUCATION

It must be borne in mind that Himalayan ranges alone account for over 18% of the country's total area. Considering other ranges like Deccan plateau, Western Ghats, etc., hills account for nearly 22% of the countrys' area, supporting a population of around 10% of the country's population, whose needs with regard to their requirements of energy, food, clothing, shelter must be assessed and satisfied through an integrated development program without upsetting the eco-balance.

So courses at Post-graduate level only are not going to help us to achieve our aim. We would requirein near future about 15% of the output of graduate engineers of the country to receive training in this discipline for which regular Under-graduate courses would be necessary. In the same proportion, technical personnel with Diploma and Certificate courses should be trained. Adequate facilities for advanced studies and high altitude research should be created to harmonize socioeconomic development with eco-preservation, eco-development and eco-generation.

SOCIAL FORESTRY AND ITS ROLE IN ECONOMIC DEVELOPMENT OF HIMALAYAN VILLAGES

R. C. Naithani*

Himalaya is facing today a great ecological crisis. This can be seen and observed in the inhabited areas where land is owned by the villagers. Agriculture has been introduced over the sloping surfaces by a gradual process of eliminating the thick forest cover. The growing population has tended to over-exploit the renewable natural resources leading to environmental degradation to the extent that the basic existance of the human and bovine population is facing serious adverse implications. As population has increased stresses have become greater and the demand on natural resources has magnified. Eventually the consequence is an imbalance between the human and animal populations on one hand, and the land, plant and water resources on the other. As the demand by the farmer is persisting and increasing one, the resources tend to become depleted and the stress upon them becomes even greater. Thus there has been set into operation a process of progressive degradation of resources and consequent environmental degradation.

The basic problem in the hills per se is that of land use management, so far there is no well defined national landuse policy in the country. The main cause of the poverty of the hill people is that they practice an occupation which is not at all economically suitable for a sloping land with complex geological formations. Nature demands that hilly slopes with folded and faulted rocks be covered with dense forests or there would be a large scale disaster. The Himalayas have been settled by human communities which migrated from the plains of northern India. So these people brought with them skill for those occupations only which were economically very successful in the plains. Time has come when the hill people are made to understand, as clearly as possible, that the economy of the plain area can never become equally successful in the mountains. The crop yielding tree actually offers the best medium for extending agriculture to hills, to steep slopes, to rocky places and to lands where raifall is deficient, It is the three dimensional forestry which achieves the synthesis of farming, tree growing and animal husbandry; they donot just complement one another but become a single integrated whole. The traditional methods of agriculture and forestry are replaced by modern forest farming and animal raising activities which are capable of adjusting to a wide variety of conditions according to the demands of specific environments.

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Marginal lands occupy a very high percentage of the Himalayan cultivated areas. The first attempt in this direction should be to map and demarcate all such marginal areas wihtin every village and assign them to raising of tree crops. An extensive land capbility survey is also essential so that areas suitable for raising of improved grasses and woodlands are indentified. Every site or surface cannot be suitable for planting trees. There are areas which according to depth of soil, aspect, surface slope, humidity and available sunshine can support only a grass cover.

It is necessary to emphasize on generation of conditions which are helpful to maintain a regular supply of water and continuation of diversity in plant life of the region. This can be done with the help of measures to be followed to retain maximum amount of rainy season surface runoff. All programmes of plantation should be related to the economic development of the area. We should plan for the region a chain of programmes relating to public education and extension involving environmental education, methods of planting trees and grasses, maintenance and care of plantations, group discussions, and similar programmes of attitudinal changes and emancipation of hill women from the tremenous physical and mental strains caused by drudgery of hard work.

Economic backwardness of the region can mainly be attributed to the primitive structure of economy, lack of any industrial activity, a limited and gradually waning resource potential, and dependence on a primitive system of agriculture. Transport costs are very high and the cost of providing economic and social services tend to be higher. General production levels are too low and accessibility to reproductive resources and income opportunities available to the people are very limited. The backlog of development has been accumulating and the economy continues to remain in primitive state resulting in persistence of poverty, migratiion of able-bodied population and lack of capital formation. One of the major socio-economic problems of the region is to find immediate ways and means to relieve the women of their tremendous physical strain, provide them with facilities of some formal as well as informal education and create locally opportunities of recreation and amusement so that life becomes attractive and there arises in them a zeal to live for the entire community.

On the basis of local requirements for a successful planning of social forestry in the temperate areas of Central Himalaya, we suggest planting of following trees, legumes and grasses to meet local requirements for fodder and fuel throughout the year and to raise improved livestock as an easy base for economic growth.

Trees: *Bauhinia variegata, Coltris australis, Grewia oppositifolia, Juglans regia, Leucaena leucocephala, Melia azedarach, Morus serrata, Robinia pseudoacacia, Populus ciliata, Prunus amygdalus, Ficus roxburghii.*

Legumes: *Atylosia scarabaeoides, Clitoria ternatea, Desmodium uncinatum, Dolichos auxillaris, D. lablab, Medicago sativa, Stylosanthes humilis, Trifolium pratense, T. repens*

Grasses: *Brachiaria decumbens, Cynodon plectostachyum, Chloris gayana, Chrysopogon fulvus, Panicum antidotale, P. maximum*

ENVIRONMENTAL PROBLEMS AND ENVIRONMENTAL EDUCATION IN GUJARAT

K. Ravi *

GUJARAT: ITS LAND, PEOPLE AND THEIR CULTURE

Gujarat the land of sea and sand, Narmada and Tapti, textile and milk Krishna and Gandhi, Lion and Neelgai Patels and Jains, Rabaries and Parsees, is a colourful state where diversity manifests in all its splendour magnificiently.

It is a land where one will see green pastures with cows and buffalows leisurely roaming,
It is a land where one will see line of ladies laden on their head with water pots over the endless sand dunes for miles and miles;
It is a land where one will see thousands of chimnies spitting smoke all the time;
It is a land where one will see nallas and rivers in red, yellow, orange green and black;
It is a land where one will see Peacocks dancing on fields with all their beauty elegance and splendour;
It is a land where one will see the fire from the oil rigs ravage the air all the time
It is the land where one will see endless squaters in the urban jungles;
It is a land where one will see Jain monks beg for food with their bowls- the spirutual bowls not the begging bowls- in their hand;
It is a land where one will see the mighty Narmada and Tapti sometimes roaring and sometimes dancing through the hills and plains;
It is the land where one will see magnificient and exquisite architectural splendour of Mosques, Temples and Jarasaras;
It is a land where one will see the love making of land and the sea;
It is a land where one will see the lion roar and roam with all its royal elegance; and
It is the land where one will see the house where the father of the nation was born, and the abode of Krishna and Somnath.

Thus, it is the land which can be the laboratory for environmental education where five different climatic and biotic

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regions are existing with longest sea coast in India among the States, and second in industrialisation, fourth in agriculture development, FIRST IN AIR POLLUTION and may be probably first in water pollution also (Sabarmati is the most polluted river in India), and also ironically (in an environmental sense) First in SOCIAL FORESTRY. And again it is one among the states in India where environmental awareness and environmental teaching and research is in full swing. Another most important socio-cultural environmental aspect is the attitude of the people attributed to the impact of Jainism and Ahimsa towards nature, particularly towards birds and animals. The strict vegetarianism (a very unique characteristics of Jainism), full adherence to Ahimsa and overall peace loving nature of the people ultimately resulted in a positive effect on the ecosystem. However, it is intriguing that it is in this land where air and water pollution is rampant which ultimately eats away the vitals of natural systems wherever such problems are existing like Ahmedabad, Baroda and Surat, almout the entire south Gujarat region (particularly polluted rivers due to development of chemical based industries in that region). This phenomenon again, interestingly, can be attributed to the basic nature and attitude of the people. The people of this State are the most enterpreunerial ones in India and the industrialisation of the State is nothing but the result of that, and obviously having the dubious distinction as the maximum polluted State.

Thus, it is the place which can be identified as the laboratory for environmental education.

Where one will find:-

a. Air, water and lithospheric pollutions attributed to industrialisation;
b. Water, lithospheric and ground water pollution attributed to agricultural development; to some extent air pollution also;
c. Anthropogenic pollution due to the growth of slums in urban centres;
d. Five different climatic and biotic regions and five different ecosystems;
e. The first well developed rural and urban social forestry network and finally;
f. Environmental teaching and research institutions, like Vikram Sarabhai Community Science Centre, Nehru Foundation for Development, National Institute of Occupational Health, Physical Research Laboratory, Space Application Centre and Centre for Environmental Planning and Technology.

THE PHYSICAL ATTRIBUTES

Gujarat has five different climatic and biotic regions, (a) comparatively humid regions of South Gujarat with greeneries in all the seasons, (b) subhumid region between Baroda and Surat, (c) Slightly arid region between Baroda and Ahmedabad, (d) semi-arid region of North Gujarat and Saurashtra, (e) extremely arid and desert regions of Kutchch, and (f) a diversified marine eco-system. This particular natural set up is an ideal arena for environmental education (a rare distinction comparing to any other State in India) as one can learn about six different eco-systems simultaneously in one State. Further, South Gujarat is blessed with many rivers and luxurious vegetation and ironically it is a curse that all these rivers and agricultural land are polluted and hence one can lean about the different aspect of water pollution, estuarine pollution, and also pollution attributed to the modernization of agriculture.

ATTRIBUTES OF POLLUTION AND ENVIRONMENTAL PROBLEMS

A. Industries

Gujarat is the second most industrialised State in India (and obviously acute water, air and lithospheric pollution problems). Ahmedabad and Baroda are the most industrialised regions in the State. More than 42% of the tootal industrial units of the state is situated in Ahmedabad and 16.8% in Baroda. While most of the textile mills (which emit different types of air pollution like particulate matter, carbon dioxide, sulphur dioxide, etc.) and water pollutants like dye stuffs and toxic chemicals) are situated in Ahmedabad, the large scale chemical, petrochemical, pharmaceutical and fertilizer, ginning and processing untis are located in Baroda (where air and water pollution is acute).

Most of the medium and small scale chemical units are concentrated in the South Gujarat region (which is blessed with number of rivers, nallas and vegetation and now heavily polluted. It is in this region one will see rivers and nallas in orange, green and red. These water pollutants are subsequently carried away to the marine system entirely geopardising Narmada, Tapti estuarine region, one of most productive estuarine system in the world). Recently Ankleshwar in Bharuch District has developed into a chemical industrial base in the State and because of the locational advantages most of the water pollutants are released into the sea without proper treatment, also the water pollutants from the Baroda Industrial cluster through a 56 km pipe line system, after the primary treatment.

Thus all these combined pollution dumping on the area between Bombay and Gulf of Cambay catastrophically affected the marine ecosystem. Many fishermen complain that they no more get sufficient catch and that tons of fishes are dead and carried away to the shore. No systematic study is made so far to identify the extent of marine pollution caused by these industries. Thus, the most polluted region in Gujarat is the region between Vapi and Ahmedabad.

The third industrialised region in the State is Surat where one will find a miscellaneous industrial concentration, Textile, Agate processing units (which mainly creates polution of particulate matter), food processing and machineries. As in the case of Ankleshwar, Surat also has got locational advantages in diffusing its water pollutants to marine system.

Though the pollution problems attributed to industrial development in other parts of the State like Rajkot, Surendranagar and Veraval exist, it is not so acute as that in the region between Vapi and Ahmebadad (because of space constraints we are not able to make a detailed statistical and location analysis of industries and pollution relationship).

B. Agriculture

Gujarat is one of the agriculturally developed States where the use of chemical fertilizers and agrochemicals (pesticides, herbicides, fungicides and insecticides) has made deep inroads into the interior villages. The fertilizer use in the State has made rapid strides during the last 20 years. The total fertilizer consumption increased many fold, i.e., 11.07 thousand tons in 1960-61, to 435.80 thousand tons in 1982-83. Such an increase in fertilizer consumption has not ony brought agricultural prosperity (in an environmental viewpoint, rather short lived) but also environmental problems. Many of the irrigation channel networks (particularly, Mahi-Kadana, Ukai) are over-eutrophicated as major portion of the fertilizers used in the field enter into the canal systems. The canal system is also toxicated due to different type of agrochemicals. The combine effect of both these contaminations resulted in several health problems as the water from irrigation canal is used for drinking purpose also. Though such problems and degradation of soil systems increase year after year, no systematic effort was so far made to understand and quantty the extent of the problem.

Another environmental prblem emerged in the agriculturally developed region of the state (Bulsar to Ahmedabad) is water logging in Mahi-Kadama and Ukai command area in Kaira and Surat District. Now ground water withdrawal schemes are under operation to reclaim the land from waterlogging by controlling the ground water levels.

C. Deforestation

Though southern part of the State is blessed with comparatively more vegetation, the total forest area, from a national angle, in the State is very less. When the national average is 23%, the forest coverage in the State is only 9.97%. Further, most of the forest is of poor quality and of deciduous and dry deciduous type. Because of the great variation in climatic and soil conditions, the distribution of forest is highly uneven. Though the vigorous social forestry programmes (first one in India) initiated by one of the earlier Governors Mr K.K. Vishwanathan, helped to increase the forest cover; 132,000 ha of rich forest have been lost since independence. Again, further 130,000 ha of forest areas are likely to be deforested under Narmada and other proposed irrigation projects (Narmada project alone will engulf 98,000 ha of forest). Thus the problem of deforestation and lack of proper forest coverage is acute in the State. In such a situation, it is heartening that the social forestry programme has taken its roots in Gujarat. Impressed by the Social Forestry Programme in Gujarat (203,000 ha was brought under social forestry) World Bank has given Rs. 65 crores for the further development of social forestry in Gujarat and adjudged the Gujarat Social Forestry Programmes as one of the best in the World (other being South Korea).

However, one important aspect of the reforestation-deforestation mechanism in Gujarat is that deforestation is taking place continuously in the traditional forest area where undulating topography exists, reforestation is mainly taking place in the plains of agricultural areas, including road and canal side plantations. The environmental and ecological impacts of this mechanism are interesting to investigate. While the deforestation taking place in the traditional hill tracks result into severe soil erosion, river and reservoir sedimentation, and flood in the plains; reforestation taking place in the marginal agricultural lands in the plains does not mitigate the problems created by the deforestation in the hill tracks. And as a result the traditional environmental and ecological problems (as shown above) oriented with deforestation continues unabated in the State. This can be solved, only through intensifying afforestation programmes and forest rejuvenation program of the jeopardised forest ecosystem. Hence, environmentally it is misleading to infer the statistical performance' of area under forestry in Gujarat.

D. Soil Erosion and Soil Salinity

Thus, though social forestry programme is progressing, the soil erosion is constantly threatening the State due to deforestation in the traditional hilly forest areas. Though detailed survey has not been made to determine the total intensity and local specificity of soil erosion, it is estimated that an area of about 40 lakh ha of land is under different type of intensity of soil erosion. The problem is more acute in the various river basins such as Banas, Mahi, Narmada, and Tapti as they are effected with the ravines called Kotar as a result of severe erosion. When most of the South and Central Gujarat region is having erosion problem, North Gujarat and Saurashtra region is affected by soil salinity (erosion also exists) attributed to ground water salinity and oceanic intrusion. The alkalinity problem is also existing in many areas, particularly in Saurashtra region.

E. Desertification

Most of the Kutchch region particularly Rann of Kutchch, is desert, an extension of the Great Dhar Desert. The total desert area (including Rann of Kutchch and Little Rann of Kutchch) measure about 1380 thousand ha. Every year the desert advances towards the east and south east direction and a considerable areas ofagriculture land is lost. Recently under the National de-desertification programme a vigrous effort is in progress to withhold the onslaught of desertification. Revitalization of desert soil, social forestry and pastoral development are some of the measures taken so far. In some areas, date palm cultivation has been introduced as a part of de-desertification programme.

ENVIRONMENTAL PROBLEMS

Air and Water Pollution

As stated above, Gujarat being the second most industrialised State in India the pollution problems obviously accompanied by such an industrialization are also high. The major industrial corridor between Mahsana, Kalol, Ahmedabad, Nadiad, Anand, Surat, Baroda, Navsari, Billimora, Bulsar and Vapi in Gujarat, and Surendranagar, Rajkot, Gondal, Jetpur, Veraval, Bhavnagar and Porbandar in Saurashtra are the major pollution pockets, with Ahmedabad, Baroda and Surat being heavily polluted. When Ahmedabad is having acute air pollution problems (Ahmedabad has the dubious distinction of being the most polluted city in India), in Baroda both air and water pollution are acute.

The intensity and variety of pollutants directly depend upon the variety and intensity of industrial activity (and also on the intensity ofthermal power generation and number of different types of vehicles). As Ahmedabad is first in Industrialisation (that too textiles, there 96 textile mills) in Gujarat, in case of pollution also Ahmedabad comes first. Sulfur dioxide which is a major air pollutant, often goes to 0.62 ppm. in the heavily industrialised zone like Naroda Road in Ahmedabad.

Baroda which comes second in industrialisation, the problem is very acute as the air pollution not only affects the human beings but also the adjoining agricultural area (particularly in the 22 sq.km Baroda pollution zone near IPCL-GSFC-Oil Refinery Complex). The agricultural productivity in these areas is going down due to air pollution and the farmers were compensated by the above companies, particularly Gujarat State Fertilizer Company. The Mahi and Viswamitri rivers passing through this areas is heavily polluted. Because of the untreated liquid effluents are released both on land and in the effluent storing wells the groundwater is also getting polluted (when the groundwater level itelf is going down, further agravating the problem).

In Surat, comparing to Ahmedabad and Baroda, the pollution problem is less acute, particularly because of the locational advantages. Most of the water pollutants are duped to the Tapti river which ultimately carry away these pollutants to the sea. In case of air pollution also the city is comparatively at an advantageous position due to a smooth diffusion process due to the atmospheric conversion mechanism because of the nearness of the sea. In the South Gujarat region, particularly the area between Vapi and Surat the river water pollution is acute as most of the industries are water polluting (dyes, chemicals, food processing and paper making) and promptly release these untreated effluents in the rivers and agricultural land. As most of them are small industrial units, the individual units are not able to afford themselves the cost of effluent treatment. In other industrialised areas of the State the pollution problem has not yet reached a dangerous level. However, the problem is on the increase particularly in Rajkot, Veraval and Dharangadhra.

Estuarine and Oceanic Pollution

As a result of heavy industrialisation between Vapi and Baroda, the marine system, particularly the estuarine region is extremely getting polluted. In many areas schol of fishes are found dead occassionally and the fishermen complain reduction infish catch. No systematic investigation is made so far to understand the estuarine and marine ecological imbalance in this region.

Thus, when Gujarat is blessed with such an industrial prosperity ,it is also equally cursed with acute environmental pollution problems (of all types like air, water land and oceanic).

Anti-Pollution Measures

Gujarat water pollution control board has come into being in 1975 as a Water Pollution Control Authority armed with the provisions of Water (Prevention and Control of Pollution) Act, 1974. According to this act all the water polluting industries have to in install effluent treatment plants, and defaulters are liable to be prosecuted, and/or fined.

The above Act, as usual was having many loopholes which the industries properly exploited and as a result many of the defaulters escaped without punishment and Board became a silent spectator before the entire episode of water pollution, many big units who were compelled to install effluent treatment system seldom operated the plant. However, Board was succeeded in bringing as many of 575 defaulters into the book and 163 units were punished so far.

Later, the Board was armed with more powers under the Water Cess Act 1977 and Air (prevention and Control of Pollution) Act 1981 and it was re-named as Gujarat Water and Air Pollution Control Board.

Though some success was achieved as far as water pollution is concerned. particularly in making many of the polluting industrial units get installed their effluent treatment system, air pollution given a grim picture. Many of the units were asked to increase the hight of the chiminies, but no significant effort was made to make the industrial units get installed electrostatic precipitator to solve the air pollution problem (probably the only existing viable technlogical solution, though sophisticated air pollution recycling and recovery plants are in operation in developed countries). Further the Board is not having any control on the transportation and domestic sectors which contribute significantly in the process of air pollution.

Thus, it can be stated that Gujarat is a unique State where all types of environmental problems (ecological imbalance and pollution of air, water, land and ocean) ironically exist with ecologically conducive vegetarian and peace loving society and social forestry programmes (ecologically positive factors) and hence, it is Gujarat which can be a full fledged laboratory for environmental education.

ENVIRONMENTAL EDUCATION PROGRAMMES IN GUJARAT

It is most heartening (appropriate and timely too) that when such an environmental degradation was taking place, Gujarat has initiated on firm footing a comprehensive Environmental Education Programme. Of course, the State Institute of Education has realised the need and importance of environmental education, particularly considering the unique environmental condition prevailing in the State. Gujarat is one among the first States to introduce environmental education in India and it has done a commendable job during the last four years.

Both formal and non-formal environmental education was started in Gujarat in June 1980 and in the first phase the formal environmental education programme was confined to lower primary section, i.e. from standard 1 to 4. The main objective of the State Institute of Education is to implement environmental education upto higher secondary level in a phased manner.

Methodology and Objectives of the Programme

A comprehensive multi-dimensional and multi-disciplinary approach is adopted within the main objective of environment as 'medium of instruction'. Here the main approach/methodology is that the environmental issues and observations have to be derived from all the subjects which are being taught to the students. So that the student will learn the environmental issues (environmental linkages) related with that subject. This effective technique helps the student not only to understand the subject and its linkage with environment, but also the comprehensive and integrated framework of a multi-disciplinary conceptual understanding of the entire gamut of man-nature relationship (in which the perfect linkages of sciences and social sciences are synthesised).

By keeping the above objectives in mind, the State Institute of Education created a new environmental division and an officer was appointed exclusively for environmental education with the primary responsibility of training the teachers and preparing 'Shikshak Nirdeshini' (Teachers guide). Subsequently teachers guide for standard 1 to 4 was prepared (Table 1).

Reaction/Reception of the Teachers

This case study oriented approach was very much appreciated by the teachers (a survey to know the effectiveness of the course for feed back input in future programmes through questionnaire method is in progress) and it is observed that many were enthusiastic in attending the training programmes.

After giving a course to the teachers, they were asked to present/teach the same thing to the students and know the reactions of the students. When the teachers were asked to give feedback, no questionnaire or methodology was given. We feel this is a slightly unscientific approach. In fact a well structured questionaire could have been given to the teachers so that a systematic observation can be amde from this exercise and the findings can be used as an input/guidance for the future programmes. Many teachers have prepared their own observations and presented in a group discussion. Unfortunately no minutes of the discussion were made. If that was done it would have been a valuable document. Such group discussions gave a golden opportunity for teachers from different parts of the State to know how the same theme was received by the students in different manner and effectiveness in other parts of the State.

It was observed by some of the teachers that some traditionally passive students showed more interest when environmental issues were presented before them within the framework given by the Institute. At the same time some students were confused. Some have asked many interesting questions. And also periodical environmental education training course (with 4 month intervals) was arranged in the Institute for the Primary Teachers.

Table 1. Course content of Teachers' Guide in Environmental Education from Standard I to Standard IV

Standard			
I	II	III	IV
Natural Environment			
Our Home Our Vegetation Our Water Our Village Air, Water and Climate Our Sky	Our House (construction of house and the materials used) Our Vegetation Our Water Our Forest Our Village Air, Water & Climate Our Sky	Our Vegetation Our Animals Our Gujarat Location, general informations Air, Water and Climate Our World	Our Vegetation Our Animals Our Body Our Gujarat Air, Water and Climate Land, Soil and Agriculture
Social Environment			
Our family Mental peace and Health Our Food	Our House Our Neighbours Our Family Peace in the locality Our Food	Our family Mental peace and Health Our Food	Mental peace and Health Our Food

Table 2. Course content of Non-formal Environmental Education (for children in 9 to 14 yr age group)

Natural Environment (Sciences)	Social Environment (Social Sciences)
Our Vegetation	Our Home
Our Waters	My Family
Our Atmosphere	Our Food
Water	Our School
Our Body	Our Neighbours
Our Health	Our Greatmen
Our Village	
Our Gujarat State	
Our Country India	
Our World	
Transport and Communication.	

Methodology of the Training Programme

Teachers from all the disciplines, i.e. language, social sciences, sciences including mathematics, were selected and a general environmental lecture series was arranged. Later a 'case study' approach was adopted by taking different environmental issues, like air, water, land and ocean pollution and rural poverty, rural health and hygiene and family and social relationships, etc. When each issue was discussed an ingeneous analytical method was adopted in which science, social science behavioural science and engineering aspects of a particular issue were peeled out and their linkages were investigted and explained to the teachers. For example when the pollution and mass death of fishes in the Kankaria lake in the Ahmedabad city was presented, (a) the layout of storm water drainage connections and its effect on the lake system was expalined, (b) the basic aspects of freshwater biology (particularly the life cycle and breeding behaviour of Tilapia fish, the main species in the lake) was explained, (c) the different aspects of water pollution and chemistry of water pollutants, (d) the industrial location of chemcial industries nearby, (e) the positive and negative biological impact of not allowing fishing from the lake, etc. were explained to the teachers. Some have succeeded in correlating/linking their experience with environmental issues.

Besides class room informations, the students were made to get involved in the school gardening programme and also 'nature observtion 'tours' near the school. The students in the 4th standards were asked to write and narrate about the home and surroundings in the class and the teacher helped them in correlating/linking those things with simple environmental issues.

Thus, it is observed that the programme is very much appreciated by the teachers and the students alike and also it was effective and succeeded in achieving the objectives. The way Environmental Education is going on now and the firm foundation the State Institute has laid, makes one very much optimistic that Gujarat experience is going to be a classical example in the environmental education in India.

NON-FORMAL ENVIRONMENTRAL EDUCATION PROGRAMME

Gujarat has made exemplary efforts in the field of adult and non-formal education. Presently non-formal education is effectively introduced in five categories in Gujarat State. Children upto 3 years, between 3 to 5 years, 6 to 14 years, 14 to 25 years, and above 25 years. Special attention is being given to the productive age group between 15 and 35 and in eight districts such special classes are arranged. Further, non-formal education is introduced in seven districts which are predominantly tribal areas (particularly for the benefit of tribals) through six hundred centres for the age group of 9 to 14. One of the most encouraging aspect of non-formal education in Gujarat is the inclusion of environmental education as an important and integral part of adult education programme. While other states lag behind in this respect Gujarat has not only taken lead but also proved that environmental education will bring tangible benefits to the target groups (mainly the villagers and tribals).

In the non-formal education three subjects namely, language, mathematics and environmental education were considered. The environmental education course was so prepared that all sciences were taught through environmental education.

Methodology and Objective

The main objective of environmental education in non-formal education programme was to mould productive citizen by giving the scientific knowledge and skill so that they will know about the personal and community health and hygiene, about agriculture and animal husbandary, social forestry and the importance and usefulness of trees, the social and political responsibility, etc., which will have a direct bearing on the total development of the State.

As in the case of formal education, the main methodology adopted here also was case study approach. Here the cas study approach is more serious and achievement oriented, because while the actual productivity or impact is secondary objective in the formal environmental education, in the non-formal environmental education the impact, involvement and productivity is the primary goal. The adult receiving the environmental education is immediately reflected on society, economy and environment. By keeping this objective in mind environmental issues are presented/taught to the adult student and he is even given the opportunity to supplement the discussion with his own personal experience. For example, when the economic and ecological benefits of social forestry is taught, the student is asked to give the details of different trees and about their nursing and cultivation. Then the instructors/teachers will further extend the discussion to the relationship between the trees and the birds, soil, climate etc.

Though some training programmes were arranged, the frequency of the training was less, compared to the formal environmental education progrmme. However, the contents and range of subjects covered were same as in formal environmntal education. Table 2 gives the details of the course content of the non-formal environmental education.

Response of Adult Students

The response from the students were very encouraging. Many of them started experimenting and implementing the knowledge and information they got from the class, particularly in the rural areas. In many cases, it was directly reflected on their upkeeping of houses and immediate environment. Most of them started replacing cow dung with agricultural waste for fuel purposes (and cow dung to soil). In the tribal areas also the response was fairly good.

FUTURE ENVIRONMENTAL EDUCATION PROGRAMMES

So far, the environmental education was introduced only upto standard 4. It is envisaged that the formal environmental education will be introduced upto higher secondary level. A general compulsory paper is proposed upto standard-9, and the State Institute is seriously thinking of introducing two special papers which aim at some sort of application and further specialisation. The Institute is also thinking to make special teachers for environmental education both at primary level and secondary level (presently there is one general paper on environment each in primary teachers training course and B.Ed. programme). Another idea is to start both open air and indoor 'Environmental Laboratories' at least one in each Taluka Headquarters for Secondary Schools).

Contribution of Research Institutes and Voluntary Agencies

As stated above, Gujarat is blessed with many internationally known research institutions particularly in Ahmedabad. Vikram Sarabhai Community Science Centre, Nehru Foundation for Development, and Centre for Environmental Planning and Technology are three among them. These three institutions are actively involved in environmental education. In Vikram Sarabhai Community Science Centre periodical environmental education training is arranged for teachers coming from different parts of the State. Teaching aids and materials on environmental education are prepared and supplied todifferent schools. Students of different age group (from 3 to 15) are given an excellent opportunity to know about nature and natural sub-systems through pictures, mini-ecosystem laboratory created in the Centre (in which different types of trees, birds, and fishes are included/maintained) and also they are being taught about the importance of conservation of nature. After the preliminary exposure of different ecosystem concepts in the Centre, students are given small projects to conduct field studies/surveys on subjects like (a) vegetation around my school, (b) vegetation in our farms, (c) vegetation in our village, (d) my village and surroundings etc. and they are asked to prepare write-ups on what they have obvserved and later a group discussion is arranged consisting of the participating students and faculties of the centre.

The Centre is mainly concentrating its efforts on the nature oriented aspects of environmental education. And as a result the Centre has succeeded in creating a positive ecological attitude among the children.

The Nehru Foundation for Development is involved is conducting research on different aspects of environmental problems creating environmental awareness among the citizen in a non-formal fashion. The Foundation collects information on the status of the different aspects of environment and publishes these informations for the benefit of the citizens. The Foundation also arranges mobile exhibitions on environmental problems with a view to create environmental awareness among the public. Seminars and symposia are also being arranged by the Foundation on different aspects of environment and also documentation of information on different aspects of environmental problems. Thus the Nehru Foundation for Development is playing an important role in educating thee citizes and creating environmental awareness among them in a non-formal fashion.

The Centre for Environmental Planning and Technology established 20 years ago is the first institution in the country to introduce an advanced multidisciplinary environmental planning course at the post graduate level. This is the only course in India in Environmental Planning (for that matter the first professional environmental evaluation course in India) meant for professionals. Here, both disciplinary (Environmental Sciences, Environmental Engineering including Environmental Architecture and Environmental Social Sciences) and Sectoral (Agriculture, Animal Husbandary, Fisheries, Irrigation, Social Forestry, Ocean Ecosystem and Resource Development, Forestry and Forest Resource Development, Industry, Transportation, Water supply, Sanitation and Sewerage, Energy Resources and Energy Planning) aspects of Environmental Planning education are taught with a high degree of sophistication so as to instrumentalize the Planners, other professionals and decision-makers in the process of achieving Economic growth with environmental balance (particularly having many beneficial economic and Environmental implications in countries like India where pollution from poverty co-exists with pollution from different development activities). Thus the environmental planning education initiated at the centre for Environmental Planning and Technology is the pioneer attempt in this direction in India and this may bring very tangible results both in achieving qualitative and quantitative welfare goals.

Thus, formal and non-formal and professional environmental education in Gujarat are well organised and on a firm footing. Hence, from the present environmental education network existing in formal, non-formal and professional levels in the State, one can be optimistic that Gujarat will be one among the pioneers in India in Environmental Education (and also ironically one of the most polluted state due to ever increasing industrial and agricultural growth).

How We Can Improve Further

The good beginning made in Gujarat in Environmental Education both on formal and non-formal and professional levels are laudable. Its approaches and objectives as we have shown above are quite innovative and consistant with the objectives of national development. However, we feel a lot of efforts yet have to be done so as to achieve the final objective i.e. make Gujarat a 'pioneer and innovator' in environmental education and thus to lay a firm foundation for economic growth with environmental balance.

One of the basic guiding principles of teachers training in environmental eduation is how best they can be made as a catalyst between the environment and the student, i.e.,

a) To help understand the student the entire gamut of man nature relationships based on facts, environmental disruption attributed to man's developmental efforts etc.

b) To help realize the student his role towards environment and how environment reacts towards him (e.g. effect of environmental pollution on air, water, shelter, food and health);

c) To help mould the student as an environmentally compatible citizen (or environmentally 'biased' individual).

Achieving the above objectives arenot so easy. A highly multidisciplinary innovative teaching approach is needed. Probably following methods, we feel, would give the desired results.

1. Teaching Innovation and Ingenuity Development Among Teachers: Conceptualization of Multi-disciplinary Synthesis Technique:

The teacher should be trained in such a way that they should be able to develop a multi-disciplinary conceptualisation within them. To this some sort of a versatality has tobe developed by giving inputs from science and social sciences, i.e. in short, an overall understanding of the entire man and natural systems. If once such an ability was developed it becomes easy for the teachers to analyse a given environmental issue and peel out different (disciplinary and sectoral linkages) aspects/linkages and thusto present before the students that, what are the different factors involved in a given environmental issue/phenomenon. Further, such a conceptualisation process helps develop multi-dimensional analytical ability within the teachers. It is in fact the analitical ability which help understand an environmental issue by bifurcating the phenomenon into different subsystems and thus understand how a particular environmental problem was evolved and which are the points that can be easily attacked so that the problem can be solved. The questions now is how a course outline meeting the above objectives can be prepared* 1.

2. Disciplinary and Sectoral Training:

Teachers should be first given a discipline-wise training. That is, the disciplines which are directly related with the environmental problems. For example, if air pollution has to be taught then, basic chemistry of the particular pollutant, the physics and meteorology which govern the diffusion of that particular pollutant, the medical aspects of the respiratory system as pullutants create respiratory diseases; the basic botany as the air pollution negatively affects the vegetation, have to be taught. Here, when the teachers are given the basic lesson on the above subjects, the sectoral linkages can also be incorporated. The sectoral linkages we mean by industry (from where pollution originates), the human habitats (where the negative effect of pollution is felt), agricultural and forestry (where the productivity is reduced due to negative impact of pollution particularly air pollution), etc. This sectoral and disciplinary linkage help imprint an unbaffling conceptual framework in the mind of the tachers and this is the beginning of the process of versatility in them. Like this, when we teach any environmental problem, such a disciplinary and sectoral inputs can be develped and taught to the teachers both in-service and pre-service, teachers training programmes.

3. Pre-service and In-service Training Progrmmes & Priorities:

Before we plan pre-service and in-service training progrmmes for teachers, we have to identify the national objectives and national policy on environmental education. Such a policy is again depending upon our priorities on national development needs. The objective should be clear; whether the main objective of environmental education is to create environmental awareness among people, or is it that we want to create environmental technicians, environmental administrators/managers/planners who will help achieve the nation environmental balance with economic development (In fact, it should be both. But the teaching inputs for both can not be the same). Thus, for creating environmental awareness we have to prepare a separate course outline synthesising the basic aspects of sciences, social sciences and engineering with an effective persuasive teaching technique which will mould the total behaviour and approach of the people compatible

*1. A methodology and wsubject combination are given in K. Ravi, A Blue-Print for environmental Education in India, Presented in the International Conference on Environmental Education held at New Delhi during December 16-20, 1981).

with environmental needs (more or less an information inculcating and imbibing technique). For creating environmental technicians, administrators/planners etc, it is skill formation technique, where the inputs given to the students will vary.

Hence, we have to train two types of teachers based on the priorities shown above. That is one group of teachers for teaching enivironmental awareness and other group for environmental skill formation. While the former can be general teachers trained with inputs from environmental awareness and related issues (package training programmmes and seminars can be arranged for in-service teachear and specific course and papers can be introduced at primary and secondary teachers training programmes for pre-service level), the latter has to be a specialist with adequate laboratory and field experiments and experiences having aptitude for such a training. The creation of a specialist from the existing general teachers with in-service training will be slightly difficult as creation of an environmentally oriented technical aptitude within him at this stage will be inoperative.

The first step is that we have to prepare the course-outline for different classes and then course-outline for teachers training programme both for in-service and pre-service level (for environmental awareness and environmental skill formation at primary, secondary and tertiary levels). Because of space constraints we are not able to discuss the course outline here*.

Another important observation is that presently there is a one sided approach in environmental education. That is, when the nature and conservation part, i.e., the ecological aspects is given proper importance, the development and toxicity aspects (different development activities like industry, agriculture etc. and the pollution and environmental/ecological imbalance created thereby) like air pollution, water pollution, land pollution etc., are not adequately included in the environmental education programme. A balanced course outline has to be prepared taking these aspects into consideration.

CONCLUSIONS

Thus, we feel that environmental education is the very foundation of our entire development endeavours. Because, it is environmnetal education which is going to mould the future generation who has to be a catalyst between man and nature (i.e. who can maintain themselves through the judicious management of their development efforts and resources without jeoparadising the eco-system which provides them resources). Gujarat is one among the

* Subject combinations and related aspects are discussed in Ravi, K. (1981), A Blue-Print for Environmental Education in India.

the few States in India who realized the importance of environmental education in its real perspective. This may be because of the serious pollution problems faced by the State, that it has to train its future citizens who will help maintain the development of the State without completely disturbing its environment. By keeping this objective in mind Gujarat has already made a good beginning in environmental education, and environmntal training programme for teachers though it needs further modification and sophistication. Fortunately for Gujarat a very well developed academic and research infrastructure exists as a supplementary factor for environmental education. However, as we have suggested above, before we chalk out programmes for teachers training both at pre-service and in-service levels, we have to prepare a National Policy on Environmental Education and accordingly we have to prepare course outlines for environmental teachers training programme.

Thus, we have to go a long way in achieving our objectives in Environmental Education and hence teachers training in environmental education also,

"Education through Environment and Environment for Education".

ROLE OF COMMUNICATION IN WASTELAND DEVELOPMENT

Kiran Desai *

INTRODUCTION

In a sense 'wasteland' is a misnomer. The land which this term indicates is in fact 'wasted land' - wasted through overuse, disuse or misuse, through deforestation or because technology to utilise the land is not available where it is needed. Since 'wasted land' does not sound as fluent as 'wasteland', especially in conjunction with other terms such as 'development', 'centre', 'council' and so on, we may continue to use the misnomer wasteland without causing any substatial undesirable change in what this land means to us. However, the difference in the connotation of the two terms may be very important in so far as that difference shaped our attitude and action in regard to land. Wasteland spells hopelessness. Wasted land holds out a promise. One of the major goals of communication in the development of wasteland is to disentangle promise from pessimism.

The estimates of wastelands may not approximate those of wasted lands, for the latter will also include those millions of little pieces of land which millions of farmers till with understandable resignation to the worth of the harvests: they till the land not because it makes economic sense to do so, but because they have the little piece of land. In any case there are no reliable data available for this peculiar but more widespread phenomenon than we would like to believe. Wastelands in India have been estimated at an enormous 300 million ha. This is 10% of the total landmass of the country and three times the land under forest. In Gujarat where salinity and alkalinity as well as wind and water erosion have affected large tracts of land, wasteland is estimated at over 7 million ha. Wasteland, therefore, accounts for about 36% of the total area of Gujarat. The estimate includes 5 million ha of denuded hills and other forest land. The estimate of wasteland in Gujarat seems to closely approximate wasted land because it includes degraded land which goes under cultivation as well as denuded forest land. To be sure, the latter is underestimated at 5 million ha. Who has not been disappointed to see what officially goes by the name of forests? The phrase dense forest is fast becoming an archaic term.

The true import of the existence of wasteland is realised when one is reminded - and we need a reminder more often than one

Centre for Environmental Education, Ahmedabad 54, India would suspect- that wastedland exists in the midst of large scale rural poverty. Indeed, it is in the light of, or, more correctly, in the shadow of the millions of poor villagers that wasteland can assume the long overdue title of 'our national resource'. The task of wasteland development can be broadly defined as one of bringing together for mutual benefit our great human resource and our vast wasteland resource. In no other case perhpas is the clich more appropriate that it is easier said than done. Only a little analysis will show that wasteland development effort holds twin promises: one of relative abundance and one of a disaster. The latter will come true or mercifully will fail to come true depending on HOW these two great resources are brought together. In any broad communication strategy or in one that is specific to an area, is implicit a faith that we are all conscious of the critical place of the HOW of the process of the two great resources, both at the bottom of development, coming together.

WASTELAND DEVELOPMENT

Though development of wasteland can presumably take many forms, almost all will agree that afforestation of wasteland is the most preferred form of its development, at any rate given the nature and problems of this land. An inocuous and seemingly simple question, asked with readiness to receive the answer without bias, can give enough leads to the communicator to perceive his role clearly: The question is 'why did people not grow trees on wastelands in the past? The answers are many, none of them by itself adequate; all of them put together, however,largely answer the question, especially if put together to create a scenario. Trees were rarely, if ever, seen as an agricultural crop. Tree growing was Nature's work. Tree felling and selling was forest department's work. Tree growing takes years, while other agricultural crops are annual or even half yearly. The economy of the rural poor is strictly geared to yearly considerations- monsoon to monsoon; the raingod makes his appearance. How do you grow trees? How do you grow them fast? What trees? Whose land do you grow them on? The private wasteland is literally imperceptible in comparison with public wasteland. If forests belonged to government, privately grown trees would be suspected, when and if they reached the market, as illicitly cut trees. There was no money available to carry the farmer through four or five years in rare cases, ten to fifteen years in most cases that it would take the trees to mature for harvest. Already too many factors to discourage even a rich individual farmer. For the poor farmer the first two or three answers, probably, were enough to perpetually keep Vandevi (the forest goddess) from appearing even in his maddest dreams.

The Missing Link

Here are then the problems of afforestation of wasteland: Attitudinal, ownership, technological, organisational, financial. The communicator has a vital role to play in all these spheres: Information is available but not at the right place; government is ready at the top level but the eagerness necessary in a task like this is lacking at the lower level; government schemes for financial backup and, in some cases, even for land ownership rearrangement exist but rarely reach the rural mass. Cooperatives have succeeded in some cases, failed in many cases, yet a tree growers' cooperative seems to be the best bet to overcome the hurdles, technological, financial and relating to market; these riddles are well nigh impossible for individual, isolated farmers to resolve. But how is a cooperative formed? What is meant by bye-laws of a cooperative? What are the steps involved in forming a cooperative? Of course, one is talking about a cooperative of the small farmers, of the landless. Financial institutions such as cooperative banks, nationalised banks and the government are ready to help resolve the financial riddles. But they have their own rules and regulations, a system whose strength based on money is made ineffective with 'ifs' and 'buts'. The statements of the neds of the poor are simple, devoid of 'ifs' and 'buts'. Who will take these simple statements to the airconditioned rooms of the financial managers? Who will tell them that poverty breeds its own accounting principles and practices? Survival of the por depends on promotion of trust; survival of the accountant depends on the prevention of bad trust. The two are like two travellers going in opposite directions to reach the same spot. Who can tell them, and how, that both can become fellow travellers without giving up their apparently different but in reality the same, destination?

Communication Strategy

Quite a complex scenario indeed. But it also throws light on some elements which should form an effective communication strategy awhich is necessary but certainly not sufficient to ensure that the fruits of wasteland development go directly to the rural landless labourers and the small farmers. Below are enumerated these elements.

1. Wasteland development must become a mass movement. To that end a general atmosphere will have to be created for it. The urgency with which afforestation work must be undertaken also determines its scale. Fuelwood and fodder situation is critical. Erosion is widespread. Damage through floods is increasing every year. If the scale on which afforestation is undertaken is not large enough the gains will be quickly offset by the mounting annual losses.

2. The audience for the communication will be a mixed one: the rural poor including the landless labourers, small and marginal farmers, by far the largest and most important; the technical and research institutions and experts working in the field; financial institutions; concerned government departments and their functionaries from highest to the lower most level; the numerous voluntary organisations and groups including those of environmentalists; legislators.
3. Continuous information flow from technical, management research institutions to NGOs, field workers and farmers. Continuous feedback from the field to research institutions.
4. Two way information flow between financial institutions on one hand and NGOs, field workers and farmers on the other.
5. Two way information flow between government and those engaged in afforestation programme at the field level.
6. Organising the tree growers. If, for instance, the form chosen is a cooperative, then all information pertaining to the formation of a cooperative to the farmers and voluntary organisations promoting such cooperatives. Information about problems faced at local level to the higher ups in the cooperative department.
7. Training of farmers in nursery raising, plantation, species selection, protection, water harvesting, low cost land development methods, etc. Training field workers and the trainers. Development of training material.
8. Extensive documentation of field experiences and widely communicating them.
9. Demonstration whenever possible. Taking farmers to see for themselves successful tree plantations.

These elements in all probability are the most important ones which should be borne in mind while working out a communication strategy. Numerous voluntary organisations engaged in rural development work are certain to be the key link in afforestation programmes. They have grass root level contacts; they have influence over the rural poor; they have a measure of infrastructure which can be used with advantage; they can organise the rural poor; they can also become the links between the sources where expertise and finances exist and the people who need them.

Communication has been a neglected field in our rural development effort so far. It is heartening to note that the awareness about developing our wastelands has come about when an equally clear awareness about the need for right and adequate communication is also seen all around.

A final word of caution. The role of communication in wasteland development effort is without doubt of vital importance. At the same time the nature of communication at least in the initial stages will be experimental. We will have to be extremely careful that we do not adversely affect, in this experiment, the vast possibilities thrown up by this unique development effort.

INTEGRATION OF ECOSYSTEM AND URBAN SYSTEMS: AN ENVIRONMENTAL PLANNING APPROACH

K. Ravi*

INTRODUCTION

Though efforts were made to understand the evolutionary process of urban system and ecological systems in isolation, comparatively less efforts were made to understand the similarity of the process of evolution between these two systems. It is interesting that in the process of the evolution of urban system and ecosystem almost a similar pattern is observed; however with an exception that the urban system lacks the self maintaining capacity (homeostatic mechanism) unlike that of the ecosystem. If the urban system also have this capability then the environmental problems in the urban system would have been minimum. However, to a certain extent this capability can be created within the urban system through environmental planning (a proces in which architects, planners and Economists will have a major say) and for that we should know the similarities and dissimilarities of both the systems in a detailed fashion.

Similarities Between the Evolution of Ecosystem and Urban System

In a natural ecosystem:

1. All the organisms and physical environment are interdependent and related to one another and activity of one element affects the other,
2. The evolution take place in a simple pattern and progress towards a complex and diversiified pattern,
3. Changes in one component affect the other component,
4. As evolution progresses the systems become mature and attain self maintaining capability (homeostatic mechanism),
5. Stability of the system is maintained through recycling/cycling of components and nutrients. These are the main laws of the evolution of ecosystem, though many more functions/laws can also be observed.

Now let us examine how the urban systems evolve and maintain themselves. In developing urban systems where industrial activity is the 'motor' of development, the development/evolution begins with a single system and gradually it develops into a complex

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system. For example, when a small industrial unit accompanied by a small set of population starts operating, a small settlement comes up; activities like construction of houses, roads, shopping complex, etc., take place which in turn attract more population, and the increase in population directly adds to increased economic and commercial activity and more industrial units having forward and backward linkage with the earlier unit come into being (which again attract more population) and the momentum takes place in an interwoven fashion.

The above relationship is strengthened in an enduring manner through production-consumption linkage, i.e., all the consumers depend upon the manufacturers and manufacturers depending on consumers (like the food chain relationship in the ecosystem, i.e., the dependency of one species on the other) and both manufacturers and consumers depending on primary resource producer/suppliers. As the momentum goes on increasing, the intensity of activity pattern changes and the entire system (urban system) moves towards a complex and diversified pattern of relationship, but with instability (unlike the ecosystem). This instability is attributed to the by-products/negative externalities (waste or pollution) created both by the consupmtion and manufacuring activities and the waste/by-product thus created is not absorbed in the system in which virgin resources are always in demand and a portion of that resources is steadily converted into waste which continuously get accumulated.

But in an ecosystem, the relationships are maintained in such a way that the waste product/byproduct of one system becomes a supporting factor for the other. For example, in a virigin soil system the rainwater helps initiate the vegetation and the vegetation gives shelter and food to an array of animals and birds and the waste product/by-product of both vegetation and animal help increase the health of soil and that soil again get strengthened though this process for maintaining an enduring vegetative and animal systems and thus progress towards maturity with self maintaining ability.

It is interesting to observe that whereas in an undisturbed ecosystem (i.e., ecosystem without man's intervention) the system by itself maintains stability, the urban system is not able to do so; and not only that the instability of urban system is spread over (in the form of pollution and waste) to the ecosystem and thereby creating total instability as the vicinity of the influence of the urban system progresses so rapidly that it disturbs the smooth functioning of the ecosystem (like transforming greenbelt areas into housing and industrial areas) and thereby enhance the complexity in both the systems and the total instability is the final outcome.

Role of Environmental Planning

Now let us enquire whether it is possible to create a self sustaining ability within the urban system and thereby maintaining stability of the total system (both ecosystem and urban system) through environmental planning. This can be done, we are able to identigfy the tterminal points of relationships of urban system and the mechanism/process of accumulation and the effects of by-products/wastes. That is,

(a) how the manufacturing activity create and accumulate wastes and how the waste interact with other systems;
(b) how the consumption activity create and accumulate wastes and how the wastes interact with other systems; and
(c) how service activities and infrastructural activities create wastes and interact with other system, etc. When we analyse this problem we will know about the origin (the linkage/terminal points), process of interaction (how it affects the other elements), its different character and manifestations.

Once this is done, we will be able to identify the resource value and nuisance value of waste from each terminal point. When we will be able to determine the resource value (through recycling) we will be in a position to find ways to make the urban system absorb that byproduct and thereby help increase the stability of the system. Again, when we will be able to determine the nuisance value of the by-product of the urban system, then we will be in a position to make arrangements to avoid the interaction of the byproducts with other elements in the system which again help increase the stability of the urban system.

To make this concept more clear, let us take the example of an urban system. An urban system operates within the ecosystem and both the systems are related inverteratly. As we did explain above, in an evolving urban system there are three main subsystem which create unabsorbable by-products/waste within the system. They are:

a. Manufacturing (production)
b. Consumption, and
c. Infrastructural activities (construction of roads, buildings, communication networks and transportation).

Let us analyse how manufacturing activity (production) create waste and interact with other systems. Different manufacturing processes in an urban system create many types of gaseous, liquid and solid pollutants. When the gaseous pollutants mainly pollute air, the liquid pollutants toxicate land, surface and groundwater; and solid pollutants (solid waste) mainly pollute land and water (many of these toxicants are biologically non-degradable). The pollutants thus entered into the urban ecosystem through different linkage points (air, land, surface water and groundwater) now enter into the metabolic system of human, animal and plant systems. Man gets maximum toxicants as the toxicants accumulated in the animals and plants also get into man's metabolic system through food chain mechanism and create disorders. When air and water pollution create different types of disease in man and animal, in plants they result in significant reduction of production and thus the resource renewability process within the ecosystem is negatively affected. Though to a greater extent intangible, the nuisance value (quantification of negative externalities) of all these interactions can be quantified.

Now, to reduce/avoid the negative interaction of these by-products and the subsequent disorders on man, animal and plants, these by-products can be transformed into useful resources (as the wastes/pollutants are mismanaged resources). An urban system, as we have stated above, create waste/pollutants through its different economic activities (like production, consumption and service activities). All these waste/pollutants can be recycled and converted into resources (both renewable and non-renewable). Recycling of any pollutant is having double advantage i.e. when we recycle a pollutant, we will be able to recover more resources (thereby add to resource stock and less demand on virigin resources particularly non-renewable resources like metal and minerals) on the hand, and reduce the process of non-renewability accuring among renewable resources (like retardation of plant growth due to air and water pollution) base and thereby, again, add to resouce stock. Thus, recycling will become a balancing factor between urban system and ecosystem and if the entire waste created by an urban system is recycled, the integration between urban system and ecosystem become complete and the quantification of by-products become feasible.

These are some of the micro level (i.e. identifying the area and interaction of each elements and sub-systems in the urban system) environmental tools which we can deploy. Through this approach, as shown above, we will be in a position to quantify different by-products of the urban system (like air polluition, water pollution and solid waste) and also the process of diffusion and interaction. Understanding of these aspects will pave the way for achieving the 'space-species activity equilibrium' (i.e., in a given space what activity can be undertaken, and what will be the intensity and how much human and other population it can support, and what will be the sustainable resource it can create to support the system and what wil be the intensity and the aprocess of by-products/waste created and how these elements are interacting in a comprehensive and integrated fashion).

Integrated Environmental Approach

As we have explained above though both the systems evolve separately, they follow some sort of similar pattern and also affect each other; because the urban system evolves itself in space' (i.e. within the ecosystem) and that is why achieving the space-species-activity equilibrium' is the key factor in achieving the harmony between urban system and ecosystem. Besides using the micro environmental tools/techniques we have shown above, a package programme of macro environmental techniques are to be deployed to obtain harmony, between ecosystem and urban system. These are: (a) Space-species approach, and (b) space-activity approach.

(a) Space-Species Approach

Space-species equilibrium explains that what will be the equilibirum relationships between the different species (vegetation and animals including man) and a given space, what will be the optimum level of the population of vegetative specis (trees, grass and other cultivation) and animal species (including man) and how both the systems can survive in a mutually benefiting fashion (positive symbiotic relationship). That is, how vegetation helps animals (including men) to survive and animals help vegetation to survive (vegetation provides food and shelter to animals including man, how animals enrich the soil system for the survival of trees and grass through its excreta and decomposition of body and how man help increse the grass and trees). To achieve this, the vegetation productivity (biomass productivity) of the space has to be determined first and then calculate how much animal population including man can survive on that system in an optimum fashion. If once that is done, then the space-resource-species equilibrium can be achieved. Here, the change in population of animals and man has to be adjusted with the biomass productivity (resources): otherwise the system may tend towards disequilibrium (with man in the top of the food chain pyramid and animals in the next ladder).

Further, any artificial inducement to create a productivity enhancement (mechanisation and all other factors introduced by man) in any system will create disequilibrium. For example, when we introduce mechanisation in agriculture, soil health is deteriorated (due to deep tillage and fertilizers and pesticide pollution) and as a result the biomass production is reduced which directly affects the dependent species negatively and thereby create a disequilibrium in the system. Another disequilibrium impetus will be initiated from the by-products of synthetic products introduced into the system. Again, most of the non-biodegradable synthetic waste neatively affect the zoological and botanical species and thereby cause illness and reduction in productivity. For example, the synthetic waste remain within the ecosystem for many years and negatively interact with the metabolic system (including the genetic system) of plants and animals and thereby cause drastic reduction in productivity) (and also cause changes in the community and the food chain relationships) which again results in a reduction in the availability of resources and hence a total disequilibrium.

(b) The Space-Activity Approach:

Thus, after attaining the space-species equilibrium (which also imply for resource equilibrium), the space activity equilibrium can be worked out. Space-activity equilibrium explains how in a given space having a given resource accruability the entire human activity interact in an equilibrium fashion so that both the systems (ecosystem and urban system) co-exist in a mutually benefitting manner. Here, the struckture and pattern of activity (housing, industries, roads, other related constructions, their intensity and interacting mechanisms, etc.) has to be examined and the resource support available from that given space also has to be considered. For example, in a given space what can be the maximum different industrial activity that can sustain, taking into account its negative effect on the existing ecosystem and the overall effect on both the systems including its population attraction (through employment) and population support (through income and goods and servies), mechanism. Keeping this as a guiding factor, housing, roads and other infrastructure have to be worked out again and keeping in mind their negative impact on the ecosystem and the overall effect on both the systems.

In a space-activity approach, different economic policies which directly or indirectly affect (or determine the intensity and direction of above activities which in turn affect the space-activity equilibriumn) the activity pattern is also included. For example, the investment policy, infrastructure,wage rate, saving, consumption pattern, etc., directly affect the activity pattern and any change in such a policy instrument will reflect on the space activity equilibrium.

Relevance of Gandhian Approach

It is here that the Gandhian approach becomes compatible with the space activity approach. The Gandhian approach emphasis on a local resource base planning. Keeping the smooth process of renewability porcesses within the ecosystem, i.e., any action which negatively affect the renewability process is not adopted. In the space-activity analysis also, guiding factor is the same. In Gandhian approach the resources within the region is planned in such a way that it should provide the overall sustainability of existence for all the dependent system (man, animal, plant, etc.). Further, that resource base should be the basic supporting factor for employment, or in other words, the employment planning should be done in such a way that it should not go beyond the resource-population equilibrium. The intensive technological involvement in the production processes which negatively affect both resource-population equilibrium and resource renewability (attributed to effluents/pollutants emmitted from high technology involved in production processes) process is avoided. Again, as we postulated earlier, the effect of economic policies and consumer behaviour affect the space activity approach. The Gandhian approach to consumption is also relevant to the concept. That is, a consumption patttern/behaviour should be within the compatible limits of resource availability within a region (or a simple consumption pattern which will suit to both resource availability and ecosystem balance). Hence, in the space activity approach the Gandhian approach (Economic Policies) can play a major role.

CONCLUSION

Thus, though we have explained a theoretical framework for integrating ecosystem with the urban system (after identifying the similarities and dissimilarities) which have complete applicability only on a 'Virgin Space', and its full implementation is slightly difficult the manner in which we have explained above. However, it can partially be applied to solve the existing environmental problems. For example in an urban system with a space-species disequilibrium, particularly with regard to vegetation, this approach will be useful. Likewise, to control the activity pattern again this can be applied to the existing systems so as to achieve space-activity equilibrium.

However, one important thing to be remembered here is the involvement of experts from many diffierent fields/disciplines. For instance in the process of the implementation of the space-activity approach only an architect can decide/understand how the built structures should be erected in that given space so that aesthetic harmony can be alchieved between the urban system and ecosystem. Again when the question of augmentation of vegetation comes in the process of implementation of space-species-approach a botanist/agricultural scientist has to decide about the harmonious combination of vegetation with space and built structures. To decide about the activity pattern of industries, only the engineers and economists can suggest a harmonious combination. Finally when the question of intgration of different elements comes, it is the environmental planner who can give the answers.

Thus, it can be summarized that the evolution of urban systems and ecosystems is almost on the same pattern except that the urban systems lack the self-maintaining ability due to their inherent failure to absorb the byproducts/waste within. However, this ability can be inculcated to a certain extent in the urban system through different environmental planning approaches/techniques (and to achieve that a new breed of environmental planners and administrators having multi-disciplinary talents and understanding have to be created to shoulder that responsibility).

ENVIRONMENTAL EDUCATION IN THE UNIVERSITIES IN KARNATAKA

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The main guiding principles of environmental education are: (1) Environment education must be precise of the economic, technological, socio-political and ethical factors and practices that create ecological imbalance, and (2) The environmental education must depict the relationship between the man and nature as different from the one that has emerged during industrialization. The education must be critical and inventive. Critical means the present social, political, economic and cultural practices whereas inventive refers to cultural ethics for the survival and prosperity of man.

The modernization of industries and the mechanization of mining activity and mineral processing have threatened the natural resources which include mineral wealth, groundwater and the fauna and flora of the region. From the syllabii of the post-graduate courses in various universities it is observed that most of the universities lack the aspect of environment, as the environment is very much essential for an earth scientist, chemist, metallurgist, mining engineers. In the present paper the authors have prepared a syllabus for the post-graduate students which shall enable them to understand the environmental impact on the natural resources etc.

The post-graduate education in Karnataka consists of two years duration in different branches. In some cases like Geography, Geology and Mathematics, three years duration course exists in some of the universities. The syllabii for the post-graduate courses do not emphasise environmental aspects of various fields. The environmental educational problem at postgraduate level must be interrelated with various disciplines like physics, chemistry, biology, mathematics and management. At present there are five universities in the state, but not a single university provides environmental education separately. The Karnataka University offers Environmental Geology at post-graduate level as a part of a paper in M.Sc. course. The syllabii cover the following:

Man and Earth, Earth processes that affect man- Earthquakes, surficial movements, Man's alterations of environment, gaseous, liquid and solid wastes and their disposal, radioactive waste, water pollution, water resources, projects, coastal installations, managing the environment - the physical system including the oceans. The biolgocial system.

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The above does not emphasise the practical application of the subject. In our opinion there should be thorough practicals or projects for identifying the ecological imbalance of the environment. The students be trained in analysing polluted samples and remedial measures to be suggested for the protection of the environment.

We feel that there should be separate post-graduate courses in environmental management. The qualification for the course must be wide open to all the graduates of natural sciences.

MODEL SYLLABII FOR ENVIRONMENTAL ENGINEERING COURSE

Air quality, water quality, toxic substances and environmental health, municipal solid wastes, energy, natural resources, ecology and biotic resources, Wastal ecology, Human settlement and landuse, noise pollution, environmental regulations, global environment, economics.

Apart from the above aspects there should be some practical excercises as necessary.

From the above study the following guidelines may be considered for the framing up of a post-graduate course in environmental education:

1. There should be a separate department of environment in the Universities for providing a post-graduate course and also research facilities must be made available to tackle the environmental problems.
2. Every district must be provided with an environmental cell to identify the problems of the region.
3. The environmental cell may communicate with the common man about the hazards of disturbing the environment.
4. In order to protect the environment the post-graduate course is a must in the Universities of India.

ENVIRONMENTAL ENGINEERING EDUCATION FOR MINING ENGINEERS IN DEVELOPING COUNTRIES

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INTRODUCTION

Mining is a hazardous profession and every year many miners lose their lives through strata falls, explosions, inundations, rockbursts and other accidents in mines. Mining operations can also result in hazardous situations for the general public as well and can cause grave damage to the surrounding environment. In the past, mining engineers have not paid much attention to the protection of environment. But growing public concern for environmental protection has forced the governments of most advanced countries to formulate stringent legislation in this regard. In the developing countries, appropriate technologies have to be found which will keep the environmental damage due to mining to a minimum but at an acceptable cost.

In the past, environmental protection has not found place in the curricula of mining engineering courses. The current emphasis on the subject has necessitated the introduction of this topic at the undergraduate level for general appreciation, as well as the development of postgraduate courses on the subject for training specialists. The purpose of this paper is to discuss the topics which should be included in the syllabii for undergraduate and postgraduate courses on Environmental Protection in Mining Areas.

Hazards to General Public and Environmental Damage

The hazard to the general public from accidental failures in an industrial plant or facilities was dramatically highlighted by the catastrophic methyl isocyanate leak in the pesticide plant at Bhopal on the night of 2 December 1984, killing more than two thousand people. The health of several thousand persons may be permanently impaired. Similar disasters of a smaller scale, involving general public, have occurred in some mining areas as well. One can cite the 1966 case of Aberfan tip slide in South Wales and the 1972 Buffalo creek dam failure in USA. As recently as July August 1984, working of the huge OK-Tedi gold mine in Papua-New Guinea had to be suspended due to leakage of toxic sodium cyanide in the nearby Ok-Ma river. Limestone mining in the Garhwal Himalayas has been suspended under the orders of Indian Supreme Court because of the possibility of environmental damage by such mining.

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Besides sudden hazards, the mining process causes slow and gradual degradation of environment through discharge of polluted water, toxic gases and dust, deforestation, land damage, and changes in hydrological conditions. The landscape of the region may also be greatly altered through creation of tailing dams, waste heaps and mineral dumps. Where blasting is resorted to, noise and blast vibrations cause damage to nearby structures, accentuate landslide problem in hilly areas and drive away wildlife.

Land Damage due to Mining

Looking at the Indian coal mining scene we find that land damage is a particularly severe problem. The projections for coal demand show that the output has to be raised from the present 145 mt to 375 mt by the year 2000 AD. The bulk of the increase will be obtained by opening new opencast mines: the share of surface mined coal is expected to go up from the current proportion of approx. 47% to about 60-65% by the turn of the century. Mahendru (1985) estimates that around 3 million cu.m soil and rock mass has to be moved every day to achieve the target of surface mined coal by 2000 AD. The extent of land damage depends on thr geo-mining conditions, especially on the thickness of seam or seams mined and the quarry depth. For an average quarry depth of 100m, a stripping ratio of 4 cu.m/t of coal and outside dumps and associated activities requiring almost the same area as that from which coal is stripped, nearly 8 ha of land will be damaged per million ton of coal production (Banerjee 1982). With the projected 225 mt per year of open cast coal an area of 1800 ha of land would be damaged per year around the turn of the century. By all accounts this is a very large area and so much land should not be allowed to become wasteland. Like the surface mining of coal, the surface mining of other minerals is also increasing and causing serious problems of land degradation. Most advanced countries already have enacted stringent legislations and the developing countries are following suit to protect the environment from such damage due to mining.

EDUCATING MINING ENGINEERS FOR ENVIRONMENTAL PROTECTION

Mining enginerers of the future must learn to win the minerals with least damage to the environment. The undergraduate mining engineering curriculum should include a paper to give the students a general appreciation of the environmental problems due to mining, and the possible abatement measures. The aim of the postgraduate (Master's level) course should be to turn out specialists who can plan and undertake measures relating to abatement of environmental damage due to mining.

Environmental science is a multidisciplinary science. Small concentrations of pollutants in water and air can be determined only with a good knowledge of analytical chemistry. Pollution dispersion in the atmosphere as well as transmission of noise and air blasts are influenced by weather conditions, and therefore, some knowledge of meteorology is also essential. Many other measurements such as particle size and mass, air and water flow rates, temperature and sound level, etc. require a good knowledge of physics. As the effects of environmental pollution are felt by the living organisms- both plants and animals, and the toxicity of an aquatic environment is generally expressed in terms of the survival of a specified animal species, the mine environmental engineers should be able to appreciate also the basics of life sciences.

An elective paper on Mining and the Surface Environment has been introduced in the final semester of the undergraduate mining engineering course at the Indian School of Mines, Dhanbad, from 1983. The syllabus of this course covers amongst other topics, mineral production and population growth, visual impact, land reclamation and subsidence, air and water pollution, tailing dam, noise, airblast and ground vibration, and legislations relating to environmental protection. We are not aware of a similar elective course being offered by any other mining department. The subject of environmental protection is however covered as a part of the general subject of mine design. For example, in Colorado School of Mines, the undergraduate "Surface Mine Design" course covers analysis of elements of surface mine operation and design of surface mining system components with emphasis on minimization of adverse environmental impacts. The paper also covers the environmental impacts.

Graduate Courses for Environmental Protection in Mining Areas

Various mining departments in different countries have introduced environmental protection in their postgraduate courses. In the Colorado School of Mines, the graduate course on "Mine Environment Planning" deals exclusively with environmentasl protection. The course on "Mine Industrial Hygiene" deals with mine atmospheric contaminants and noise pollution.

In the Royal School of Mines (Imperial College of Science and Technology), London, topics related to mining and the surface environment are covered at the graduate level and two of the Masters thesis submitted in 1982-83 were related to environmental topics. The Imperial College of Science & Technology has started a separate course for Environmental Technology where one year M.Sc. course is offered. A student taking the above course has to take the core courses and then opt for specialisation in environmental problems related to his special interest including mining. The core course on "Primary Mineral Production and Energy" for example includes "constraints on mineral production, limits to growth, mining and pollution, world energy requirements, fossil fuels, pollution and energy" etc., and the optional course on "Mineral Production and the Environment" covers topics on environmental impact of mining, waste utilization, reclamation and legislative concepts.

Structure of a B.S. Environmental Engineering Programme

The Middle East Technical University in Ankara (Turkey) offers a 4-year B.S. degree in Environmental Engineering since 1973. This is rather uncommon. The environmental subjects may be broadly grouped under two heads of Environmental Sciences (Environmental Microbiology and Environmental Chemistry), and Environmental Technology (Water, Air and Land Pollution Control) and the emphasis in the graduate programmes may be given on either of the groups depending primarily on whether the course is offerred by an applied science faculty or an engineering faculty.

CONCLUSIONS

Environmental Engineering education in many universities has started as an offshoot of civil engineering departments. However where the need of an industry is more specific, as in mining, it would be better to formulate separate and specific programmes. Some universities abroad have already introduced full undergraduate courses in Environmental Engineering but we feel that the inter-disciplinary nature of the subject can be better covered in a postgraduate programme. There is also a need for short-term industry-oriented courses for in-service people who did not benefit from such courses earlier.

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EDUCATIONAL IMPACT OF DEMONSTRATION PROJECTS FOR IMPROVEMENT OF RURAL HOUSING

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INTRODUCTION

Housing and environmental conditions in human settlement in rural areas of developing countries are far from satisfactory. According to available evidence there is considerable shortage of rural housing in many of the developing countries. Taking Asia as a whole the magnitude of housing needs (urban and rural) during 1985 is given in Table 1. It may be seen that rural housing deficit is about three times the urban housing deficit.

At the country level it has been estimated by the National Buildings Organisation that by 1985, the shortage of housing in India would be of the order of 24.7 million; out of which 18.7 million is in rural areas alone.

Table 1. Urban-rural population, world and Asia, 1985
(Million)

Regions	Urban	Rural
World, Total	2198	2750
Developed Areas	928	347
Developing Areas	1270	2403
Asia	943	1931
East	500	682
Middle-south	270	867
Southeast	116	318
Southwest	57	65

Source: UN Monthly Bulletin of Statistics

Environmental Conditions

While it is true that the villages and rural settlements in the developing countries of the region are not overcrowded as the large cities and metropolitan areas, in many other respects housing conditions are unsatisfactory. Low cost rural houses usually consist of just one room hut. In India, for instance, some 34 percent of the rural households occupy only one room.

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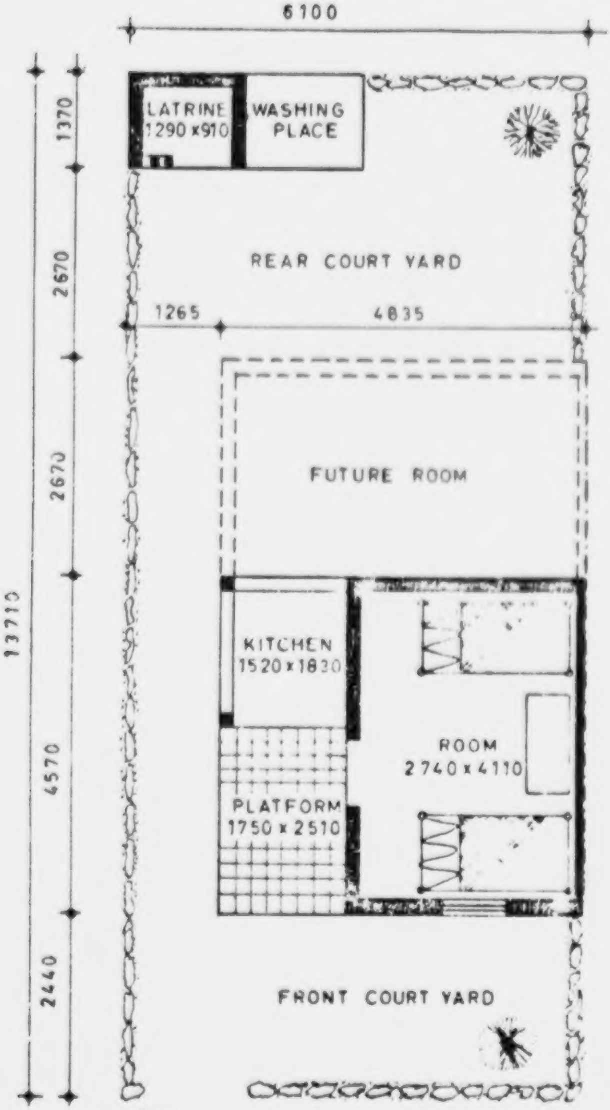
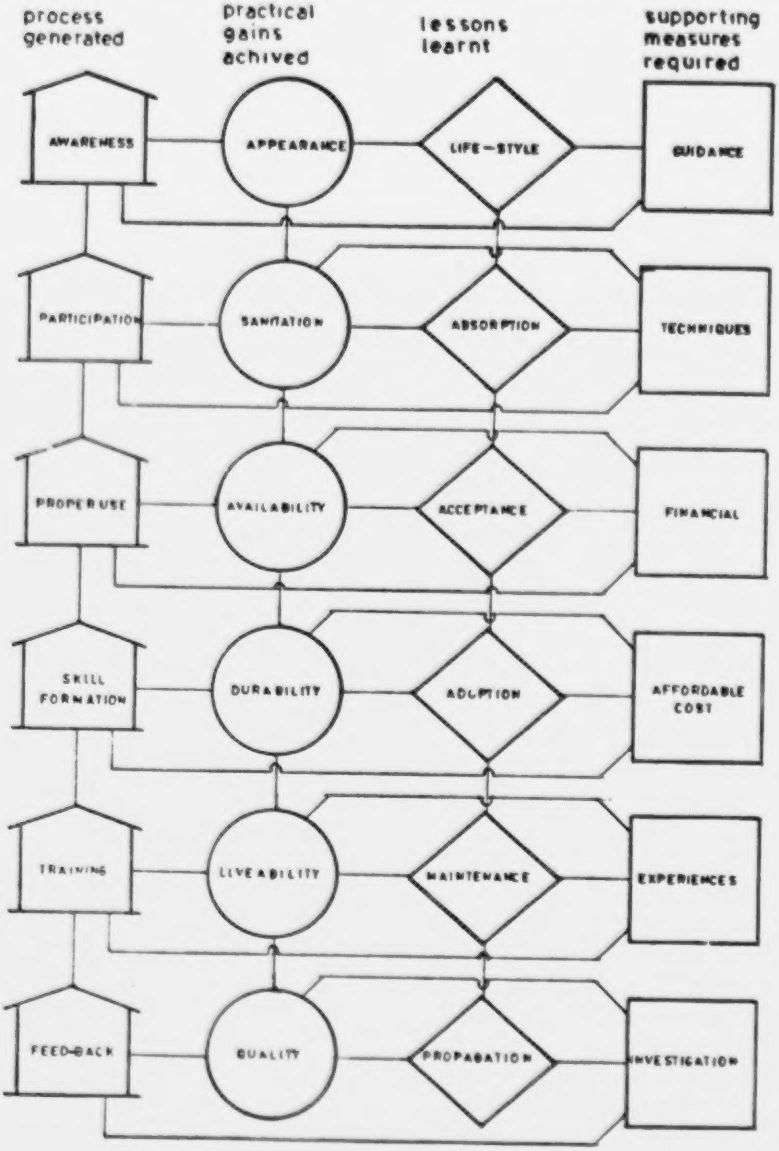

6100
LATRINE
1290 x 910
WASHING
PLACE
REAR COURT YARD
1265
4835
FUTURE ROOM
KITCHEN
1520 x 1830
ROOM
2740 x 4110
PLATFORM
1750 x 2510
FRONT COURT YARD
1370
2670
2670
4570
2440
13710
plan

plinth area / unit 20.0 m^2

Fig. 1. HOUSE FOR RURAL LANDLESS



IMPACT OF ENVIRONMENTAL EDUCATION

process generated
practical gains achived
lessons learnt
supporting measures required
AWARENESS
APPEARANCE
LIFE-STYLE
GUIDANCE
PARTICIPATION
SANITATION
ABSORPTION
TECHNIQUES
PROPER USE
AVAILABILITY
ACCEPTANCE
FINANCIAL
SKILL FORMATION
DURABILITY
ADOPTION
AFFORDABLE COST
TRAINING
LIVEABILITY
MAINTENANCE
EXPERIENCES
FEED-BACK
QUALITY
PROPAGATION
INVESTIGATION

Fig. 2.

Inadequacy of accommodation for the family and overcrowding are therefore evident. In many cases, for want of a separate kitchen, cooking fires in the living room fill the house with smoke.

The areas surrounding the houses are often polluted owing to lack of adequate drainage and sanitation. Latrines are either not built or are insanitary and inadequate to serve the number of people that use them. Potable water supply is generally not available and water for drinking is obtained from wells, ponds, rivers, streams, etc., which are often polluted or are exposed to the risks of pollution.

With few exceptions, rural villages have not been planned. Their layout is generally haphazard or disorderly. The villagees are mostly congested with narrow winding lanes, which become muddy and slushy, particularly during the rains. The villages and neighbouring towns are also not properly connected with good roads for inter-communication and this inhibits their economic and social development.

Several reports and observations have referred to the poor conditions of rural housing as being the most important cause of poor health of inhabitants in rural areas. A number of surveys have also revealed that the vast majority of rural households in the developing countries subsist with only the barest minimum of or often without essential housing services and facilities.

Environmental Education Through Demonstration Projects

The NBO is engaged in promoting improvement in rural housing and environmental conditions. Twelve Rural Housing Wings of NBO have also been established in the country for research, training and extension in rural housing and village planning. These Wings are located at Chandigarh, Bangalore, V.V.Nagar, Howrah, Jodhpur, Srinagar, Trivandrum, Varanasi, Ranchi, Simla, Madras and Gauhati

NBO is implementing a scheme for construction of clusters of demonstration low cost houses along with items of environmental improvement. So far 73 cluster demonstration housing projects have been taken up in selected villages in different geo-climatic regions with varying socio-economic conditions as shown in the map of India.

In each cluster demonstration housing project a set of 20 houses catering to the needs of economically weaker sections of the society are put up at lowest possible cost making improved use of local materials and self-help. On a plot of 90 sq.m (100 sq. yards) a house is pout up to provide minimum accommodation in a plinth area of 20 to 25 sq.m comprising of atleast one living room, separate kitchen and an a verandah (Fig. 1). An additional room can be constructed for future requirement.

A separate built-in sanitary latrine and a bathing place are also provided in the house at the rear backyard where a cattle-shed can also be put up. There is a front yard for meeting the family needs of rural occupants.

Improved used of local materials is made for building more durable houses. The aspects related to protection of houses in areas prone to floods, earthquakes, cyclones etc. are also given due attention. The cost of each house is not to exceed Rs 5000 in all parts of the country except high altitude hilly regions where the cost can be Rs. 7500. Alongwith more durable house, items of environmental improvement such as provision of smokeless chulah, sanitary latrine, drainage, bathing place, arrangement of water supply, paving of streets, orderly layout of houses to achieve a density of 60 houses per hectare with provision of open spaces, community hall, biogas plant, plantation of trees etc., is also made in each cluster demonstration housing project.

With the technical guidance of NBO and assistance rendered by the Regional Rural Housing Wings of NBO, large scale rural housing schemes have been taken up in many states in the country such as 25,000 houses in the state of Punjab, 5000 houses in each district of Assam, 54,000 houses in Rajasthan, 75,000 houses in Kerala and 65,000 houses in Andhra Pradesh.

IMPACT OF ENVIRONMENTAL EDUCATION

As has been stated earlier the cluster demonstration housing scheme is intended tomotivate the rural people in improving their built environment. The promotion of informal education of the rural people is therefore the main objective of the scheme. In this paper the impact of the cluster demonstration housing scheme has been briefly highlighted indicating the important practical gains achieved, the lessons learnt and supporting measures that are required to propagate housing and environmental improvement in rural arteas have also been identified. Although informal surveys, studies and interviews have been made by NBO and RHWs to assess the impact of cluster demonstration housing projects in improving the built environment, it is rather difficult to make a proper assessment of the impact because of several technical, social and economical factors that are involved such as the new concepts which bring about a change in life style of the rural people, tradition bound nature of the villagers which is deep rooted in beliefs customs, rituals etc., a poverty of the rural population and comparatively high cost of construction of houses and provision of essential services for environmental improvement which are much beyond their affordable limits etc. The process of environmental education through cluster demonstration houses has generated (Fig. 2)

i) Awareness about the innovative techniques of construction of houses at low cost making improved use of local materials and self-help and for environmental improvement in and around the dwellings.

ii) Participation of the beneficiaries in implementation of the innovations in meeting their housing and environmental needs.

iii) Proper use of the facilities provided and their up keep and maintenance.

iv) Skill formation through developing know-how and participation in the construction works.

vi) Training of artisans who had been employed for adoption of innovative use of materials and techniques.

vi) Feed back of experiences in the use of dwellings and the essential services for environmental improvement.

Practical Gains

As has been found from actual observations, the following positive gains have been achieved through the cluster demonstration housing projects:-

i) Tidy appearances of the housing cluster put up
ii) Improved sanitation in and around the houses
iii) Availability of water supply
iv) More double houses
v) More liveable and comfortable dwellings
vi) Better quality of environment

In-depth studies are required to ascertain the extent of practical gains achieved over a period of time from the cluster demonstration housing projects.

Lessons Learnt

The survey and studies undertaken have brought forth several lessons that can be learnt in educating the rural people in the improvement of housing and environmental conditions through cluster demonstration housing projects. These include:

i) Changes in life-style is greately dependent on social and cultural background of local people which should be given due cconsideration.

ii) Slow-Change is due to slow absorption of new ideas on account ofsocial, economical and cultural factors.

iii) Extent of acceptance is dependent on life style of the rural epople, the level of technology soughtto be introduced and the cost of construction to be incurred etc.

iv) Actual adoption of technique is dependent on the ability of rural people, techniques, new ideas and to put up in practice.

v) Proper use is dependent on the know-how acquired and the techniques of poroper up-keep and the maintenance of facilities and disadvantages of new facilities provided.

Supporting Measures Required

In order to propogate the practical gains achieved and to account for lessons learnt in the cluster demonstration housing projects, the following important supportive measures are required to be taken for further propogation of innovative techniques methods for improving housing and environmental conditions in the human settlement in rural areas.

a. Day-to-day technical advice needs to be provided in the proper use of dwellings and various facilities provided for environmental improvement.

b. Techniques and methods of up-keep and maintenance of dwellings and essential services which are provided need to be imparted to the local population.

c. Financial support by way of loans and subsidiesare required to be made available who intend to adopt these improvements in housing and environmental conditions.

d. Cost of houses and essential services should be brought to affordable level by adoption of appropriate technologies.

e. Feed back of experiences over a period of time should be organised for making necessary improvements and modification taking into account the local situations.

f. Investigations and research in local problems should be undertaken to evolve appropriate technologies taking into consideration the variety of local conditions.

CONCLUSIONS

The scheme of putting up clusters of demonstration low cost houses in various geo-climatic conditions with varying socio-economic situations is an important five-year Plan of NBO which is being implemented by its regional Rural Housing Wings. The assessment of the impact of environmental education generated by the scheme has clearly brought out the following:

a. At least one cluster demonstration house should be put up in each district in each state in order to have country-wide impact of the scheme.

b. Wide publicity through audio-visual and mass media should be made to popularise the innovations that have been successfully adopted in cluster demonstration houses.

c. Innovative techniques for building houses employing improved use of local materials and techniques for environmental improvement should be included in the curricula for imparting education to architects, engineers, builders, planners, etc. as well as to artisans engaged in building construction work.

d. Informal training programmes and exposition at school level should be introduced for propagating improved housing and environmental conditions.

ENVIRONMENTAL IMPACT OF INDUSTRIAL AND URBAN SETUP ON TRIBAL WOMEN OF BIHAR AND M.P.

Aruna Shrivastava* and G.P. Shrivastava**

INTRODUCTION

In one of the public meetings at Bhuwaneshwaar, Orissa, in 1978, our late Prime Minister Mrs. Gandhi said that she deeply feels that she was a tribal girl in her previous birth. Although no body could ever know convincingly about his or her previous incarnation, yet it seems quite logical that probably her guess was correct. Her deep attachment to dense forests and mountains, her love for nature, her affection for wild animals, her open and large heartedness, her simplicity, intense confidence, unflinching behaviour under adverse and unfavourable conditions, capacity for hard work, matchless energy to bear with the bodily and mental sufferings and her eagerness to face the dangers by keeping herself in the forefront were some of her outstanding qualities which testify her claim about her previous birth.

In this phenomenal world every behaviour of human beings cannot be analysed simply genetically. Mrs. Gandhi may be right in her claim which is witnessed in her deep concern and love for the tribals. Her last public visit was to tribal population dominated Orissa State. During this trip she spent most of her time in the tribal areas. During one of her public meetings at Amarkote, Orissa, she spotted out a group of Konda tribal girls amidst a huge public gathering. At the end of her public address she silently made her way towards this tribal group and felt extremely relaxed by putting her hand over the shoulders of the surprised tribal girls. She started talking to them to which the girls responded in their own language. The language was only an apparent barrier between them as they knew not each other's language, yet the language difficulty seemed to melt very soon because of the behaviour of equality which instantaneously generated rapport among them. The entire population of 40 million tribals of India were so mcuh attached to Mrs. Indira Gandhi that in her death they have lost every thing. If by her death they feel that they are totally ruined and exploited it is simply because she belonged to the tribals from the core of her sentiments and the tribals in turn gave themselves up into her keeping as her belongings.

The aforesaid prelude is quite in tune with the theme of this paper as no other example than the personality of Mrs. Gandhi could have depicted so nicely and vividly the characteristic features of Indian tribal women.

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Tribals are supposed to constitute the most stable societies since they remained unaffected by the social cultual and economic evolution of thousands of years. Most of the tribal localities in India are located in forest areas and thus the tribals have become an essential component of the forest ecosystem. Upto the first half of the present century, tribals lived in close symbiotic relationship with the forests (Mishra 1980). Industrialization and urbanisation are causing tremendous stress on the forest resources which directly affect the tribals (Shrivastava 1984).

In tribal societies women occupy most important position in the family. Lack of informative material on tribal women has led to the present study. The environmental impact of industrialization and urbanization on tribal women is assessed by studying first the activities of tribal women in the natural habitat which is invariably a forest and then analysing her role in the industrial and urban setup beginning with the causes of her migration into a new environment.

Tribal Population of India

According to 1971 census about 40 million tribal people belonging to over 300 tribal communities live in India. Of this about 9 million belong to Madhya Pradesh and about 5.5 million to Bihar. The male-female ratio in both the states is about 60:40. By superimposing the forest map on tribal map of India it becomes readily evident that the original tribal habitations are mostly distributed in the major forests of India. Such a situation arose as a result of peculiar tribal history. Upto the British period the tirbals were subjecteed to live in complete isolation in dense foreests for centuries. This considerably prolonged habitation in forests has made the tribes as forest-man. The forests and tribes or tribes and forests are just the two sides of the same coin (Mushran 1983). The tribal people are more experienced in matters concerning forests compared to even skilled foresters. The entire economy and environment of the tribes is based on the forests.

About 4 million Gond and Bhil population is spread over M.P., Maharashtra, A.P., Rajasthan and Gujarat. The Santhals have over 3 million population in Bihar, Orissa and West Bengal. Andamanese was the smallest tribal community of only 18 persons in 1971. But this has become most important from anthropological point of view since it is at the verge of extinction.

Bhils, Gonds, Santhals, Minas, Mundas and Orans, each with a population of over 1 million, are major tribes of India. Hos, Khonds and Kols are second major tribes followed by 42 tribes as third major group with a population of upto 500,000 each. Ranchi, Singhbhum, Santhal Pargana, Koraput and Bastar are the most important Indian districts which have more than one million tribals each.

Tribes of M.P. and Bihar and Their Distribution

The tribal population of India is divided into three geographical zones of which Middle Zone is spread over the area between 20-25 °N and 73-90 °E. This zone has highest tribal population of over 20 million and it includes the states of Bihar and M.P. The important tribes of these area are Abujhmarhia, Agaria, Baiga, Bhaina, Bharia, Bhatra, Bhil, Bhilala, Binjhwar, Bhuiya, Bhunjia, Dhanwar, Dhoba, Dhurwa, Dorla, Godba, Gond, Halba, Kalang, Kamar, Kawar, Khairwar, Kharia, Khond, Kol Korku, Korwa, Majhwar, Munda, Muria, Nagarchi, Nagesia, Nihal, Ojga, Oraon, Pao, Pardhan, Saharia, and Savar.

RELATIONSHIP BETWEEN TRIBAL WOMEN AND NATURAL HABITAT

In general, Indian tribes are a component of forest ecosystems. The women folk is mainly food, fodder and fuel gatherer so it causes greatest impact on the plant comunities of the forests. This relationship is envisaged by knowing the plant community of thse forests. In Bihar the major forests are spread over Chhota Nagpur plateau. The forests are mostly sal forests and are less productive. But these areas are rich in mineral resources. In M.P. over 30% area is under forest cover mostly situated along the hilly tracts. Buchanania, Cassia fistula, Terminalia, Bamboo, Aegle, Semecarpus (Bhilma), Bijasal, Anjan, Ber, Butea, Dhawa, Haldoo, Khair, Kullu, Tendu, Teak, Sal, Salkai, Semal, Saja, Sheesham, Madhuca, Harra, Bahera, Amla, Kenth are some of the important plants of this area. The forest tree species provide several minor forest products besides timber, fuel and bamboo. These minor produces not only constitute important revenue source but also provide work to tribals, particularly women, in such periods of scarcity when no agriculture is possible. Tendu leaves, sal seeds, gums and resins, honey, and several important medicinal products are collected mainly by women. In M.P. alone the tribal women earn about 300 million rupees from these minor products.

Thus, the tribal women play an important role in sowing, transplanting weeding, harvesting and threshing of crops; looking after the cattles, grazing and fodder collection; collection of minor forest products and fuel wood; and marketing the products, besides their routine domestic work.

All these activities have tremendous impact on the forest ecosystem which are briefly discussed here to assess finally how industrialization and urbanisation diminish the impact of women activities on our forest resources. Although tribal people have a natural instinct for conservation of their habitat but ever increasing economic stress inflate these activities more and more. Under such circumstances the utilization assumes the shape of exploitation and the forests get gradually degraded.

Ecological Aspects of Shifting Cultivation

Shifting cultivation has greatly disturbed the development and succession of forest communities. Scrub vegetationl pasture lands and thatches in Himalayas are mainly man-made. Discussing the effects of shifting cultivation in the north-west Himalyaas, Hamilton (1948) stated that the fertility of soils is exhausted and people are compelled to search for fresh lands to raise food crops. It has been suggested that in tropical areas shifting cultivation should not be allowed as it not only destroys vegetation and fertility but it causes extensive soil erosion and floods.

For shifting cultivation tribal population move from place to place at an interval of 3-4 years abandoning old dwellings and clearing the new areas. Thus irregular patches are created in the forests and forest structure is affected tremendously. The presence of exotic species in otherwise luxuriant forest stands is the direct result of shifting cultivation. Compared to other human activities which are usually located at the periphery of the forests, shifting agriculture seems to be more harmful as the present study indicates that most of the shifting agricultural patches lie well within the centre of the forests. Burning of stumps during shifting cultivation causes total loss of the regenerating seed stock. Some of the plant species thus get totally eliminated from the respective forests.

Impact of Grazing

Unlike rural areas, in tribal areas mostly women folk is involved in grazing their cattles. Cattle are taken within the forest for grazing and different grazing patterns are formed with respect to the type of cattles. In the cattle shed also the feed is provided from the forests. Goats bring about large scale destruction by freely browsing over all types of vegetation. Their penetration into deeper forest area was maximum compared to cows. Buffaloes are not very common, particularly in Bihar. This may be correlated with the scarcity of water. Surplus animals which have stopped milching are left free in the forests for ever. This causes almost total exclusion of shrub layer.

Cattle trade is an additonal danger to the forests. Traders from Gujarat and Rajasthan take their cattle herds to distant areas through these forests of M.P. and Bihar. While on their way these migratory herds cause large-scale destruction of forests by grazing.

Effects of Grazing on the Ecosystem

Grazing affects the forest structure by altering regeneration, seedling damage, and loss of germination due to compact soil. Browsing by goats destroys the understorey of shrubs and tree branches nearer the ground. Forest productivity is usully low near the forest periphery (Lall 1982). This is attributed to the large scale grazing near the forst margins.

Cattle Population

Tribal women are responsible for looking after the large cattle population. The percentage of cattle population in relation to tribal population varies greatly in different states (Whyte 1964): 0.1% West Bengal, 0.5% in TamilNadu, 1% in Assam, 2% in Kerala, 110% in Jammu Kashmir, 80% in Himachal Pradesh, 35% in Rajasthan, 25% in Madhya Pradesh and 20% in Bihar.

Fuel and Timber Demand

Besides fodder, forests are required to meet the timber and fuelwood demand of the dependent tribal population. Thus forests are subjected to lopping, hacking, over-felling and fires, etc., resulting in depletion of growing forest stock. According to Puri (1960) shifting culivation is a pernicious system, which is probably as desructive to forests as any other act of man. It is a common experience that the forests near tribal habitations are usually poor compared to those situated at a sufficient distance from human settlements.

Stebbing (1921-26), Champion (1923), Mobbs (1941), Misra and Puri (1954) and Mohan and Puri (1955) have presented accounts of the history of man's interference with Indian vegetation. It is interesting to note that certain forest communities owe their existence directly to the interference by man.

Fire

Forest fire is started mostly by women who set the litter on fire to facilitate collections of fruits and seeds. Fire is a predominant destructive factor. Litter is a rich source of minerals for the forest. Burning the litter deprives the soil of the organic nutrients and other long-term effects on the soil. Many important seeds and seedlings are also destroyed and therefore, forest regneration is retarded.

Forest Exploitation

Forests yield many products like: Tendu, sal, Mahua and Butea leaves, honey, fuelwood, sal and Mahua flowers, Mahua, Harra, Bahera, Charkoli, Bhelwa and Amla fruits, sal and teak timber, all possible free wood for fuel, Dioscoria tubers, gums and resins from Sterculia, Anogeisus, Terminalia and Cochlospermum, fibres for rope, grasses for fodder, broom and thatching.

All these constitute about 40% of total forest products. The exploitaton by tribal women folk does not result in the desired economic benefit since the middle men of this unauthorised trade exploit the tribals. Forest exploitation ultimately results in degrading the forests.

INDUSTRIALIZATION AND URBANISATION

During past 30 years fast industrialization has taken place due to which the natural resources are constantly sought and are gradually depleting since more and more forest land is being acquired for other purposes.

Bihar has rich deposits of coal, iron, mica, copper, silver, manganese, chromite, lead, china clay, lime stone, platinum, radium, and slate. Owing to these deposits paper, fertilizers, iron and steel, jute, aluminium, heavy machines, and other allied industries are spread over a large area of Bihar. Jamshedpur, Bokaro, Sindiri, Ranchi, Dalmiyanagar, Samastipur and Barauni are some of the most important industrial places of Bihar.

In Madhya Pradesh coal, copper, limestone, manganese, iron, marble and diamond are the most impotant deposits. Paper, iron and steel, aluminium, cane-sugar, textile, China clay, cement, gelatine, plastic, heavy electricals and machines, pesticides and battery are the major industries spread throughout the state. Besides this, several hydrothermal and hydro-electricity projects are there in the vicinity of dominant tribal areas.

Impact of Industries on the Tribal Habitats

In M.P. and Bihar the induсries have developed in two ways, either by encroaching upon the tribal habitats directly or by heavily depending upon the forest resources. In both ways the tribal population is intimately affected. The basic forest eco-systems have been transformed into industrial or urban centres. Large scale utilization of forest resources have degraded the forests and the native tribal societies are compelled to migrate to new industrial societies.

Changing Role of Women in Industrial Societies

The hard life in the native areas of tribals is getting gradually eased particularly for women. According to government reports about 10% tribals are now working in the industrial areas. The women are mostly engaged as labourer in various factories which has made them at least financially secure. Some have adopted to more scientific agriculture on the developed land which is provided to them as a compensation for dislodging them from their native forest lands. In Urban areas many women have taken up domestic jobs. Eastern M.P. and Western Bihar tribal areas have come under heavy influence of Christian missions and exposed more to education compared to other tribal areas of these states. The younger women are getting gradually more and more engaged in nursing trade. The education policy is supporting more and more tribal women to take up education but mostly they go upto high school education. The parents are still against higher education. There are ample opportunities for their progress in the urban set up but full benefit is not reaped.

Heavy industries have not benefitted the tribals to the extent of small-scale industries. Here again it is the skill of women folk which is recognised and they get benefitted. The heavy industries are based on the concept of power subsidy, sale tax subsidy, and on concessional rates of interest, none of which ever benefit the tribals directly. On the other hand cottage industries like sericulture, handloom, basket making and some cooperative schemes have shown better results in improving the status of tribal women.

Apparantly the industrial set up seems to be more favourable for tribal women compared to their native environment. Usually the tribal woman is seen as a potent tool of degrading the forest ecosystem, and the environment there is considered more harsh for them. But both systems have some benefits and drawbacks. According to Raizada (1948) the expectation that the industrialization of tribal areas would help in improving the economic conditions of the tribal community has proved largely illusory. Major industrial projects located in the tribal areas have worked to the detriment of the tribals by uprooting them from their home. They failed to provide opportunities to all those who were disturbed. The responsibility of the project sponsor ended just with the payment of compensation for the acquisition of their land.

The rehabilitation and training programmes have also failed utterly simply because they are not able to produce goods of marketable quality.

The Concept of Forest Degradation by Tribals

The activities of tribal women have following impacts:

a. Complete landscape changes by changing the vegetation and soil conditions.

b. Modification in regeneration capacity of plant species.

c. The biotic influence changes growth paremeters of plants.

d. Vegetation composition and structure changes. Plants of drier habitats invade the forest areas.

e. Forest canopy and microclimate are intimately related. By exploiting the foliage not only climate is drastically changed but the whole biogeochemical cycle is adversely affected.

f. Forest damage is caused on periphery by grazing, and in the interior by shifting cultivation.

It is true that all these activities are deleterious for the forests but the industrial development is even more dangerous for the existance of forests. Tribals never cause so much degradation of forests as is caused by industrial and urban expansion. More and more forests are being encroached and are becoming extremely patchy. However, the tribals in industrial areas have largely benefitted and the status of women appears much improved particularly in Bihar.

Yet, it cannot be advocated that the entire tribal population should be shifted to industrial areas as there are other important considerations which should be taken into account. Datt (1983) points out that resource consumption always increases in the developed society. Thus removal of tribal people from forests cannot lower down the resource consumption of forests, rather it will be increased.

The difference in resources consumption in a backward and developed society is due to the differences in the level of living and the environmental impact. As man shifts from primitive society towards an advanced society the variety of consumable goods greatly increases. Public consumption in terms of well developed town, roads, hospitals and other social amenities also increase greatly. In other words even 1% shift of tribal population towards urban society will make more demand on resources compared to 10% of them living in the original habitat.

This fact is quite evident from the way of living and life style of the tribal women of Bihar, a large population of which is now becoming dependent on industrial society.

CONCLUSIONS

Forests are renewable resources and are useful to man in many ways. Since the tribals and forests go hand in hand it is quite imperative that study of the role of tribals in manipulating and changing forested areas has gained importance in the context of shifting tribal populations from forests to industirial areas. Usually sizeable forest areas have been cleared by tribals for agriculture. This has such repurcussions that while the forests are diminishing, the area so gained for agriculture is not very profitable.

Government financing schemes aim at holding back the tribals within the confines of their original home in the forests. Whereas tribal migration from forest has resulted in minimising the destructive pressure by the tribals on the forsts. Holding back the tribes in the forest means reducing our forests into patches no doubt but industrialisation is making our forests more patchy. As already pointed out earlier that the tribal people live in symbiosis with the forest for thousands of years, they are born naturalists. Their skills and talents regarding various aspects of forestry should not be overlooked. It is for this reason the forest nurseries and the social forestry projects are taking the full advantage of the nursing care of plants by the tribal women.

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CONTRIBUTION OF YOUTHS IN ENVIRONMENTAL PROGRAMMES IN INDIA

V.P. Kudesia and S.P. Verma*

The recent accelerated changes in the balance of nature have created a consensus of opinion on the gravity of the situation for humanity as a whole. This is due to rapid technological and social changes and irrational exploitation of the resources of earth. in disregard to the environment. The investigations of environmental changes have become important.

The sense of responsibility of people to protect and improve the environment is a vital part of fighting environmental degradation. It is the actions of man as planner. builder. farmer or consumer which cause environmental deterioration. Therefore it is on man's attitude that the future of our water. air. soil. forest and mineral wealth ultimately depends. Hence it is important that every one becomes environmentally conscious through proper environmental education.

URBANISATION. YOUTH AND ENVIRONMENT

This is well known that India is an agricultural developing country. A majority of people live in villages. they should love to stay in an open. healthy environment. yet several rush to find jobs and to settle down in urban areas. But why do they leave villages. Diversity of jobs. marketing facilities. civic amenities and large settlement of human beings make urban areas attractive. Urbanisation is man's ingenious process of governance of a large group of people and their daily lives. Economic aspirations and political mechanism lend vlaue to urbanisation.

Environment of Urban Areas

The quality of urban environment gets upset because of uncontrolled growth. verticular density. foul air. inadequacy of basic facilities of drinking water. sewage and waste disposal. Population congestion. heavy street traffic and industries produce a canopy of smoke and harmful gases. Vehicular exhaust spread air pollutants such as carbon monoxide. nitrogen oxides. organic vapours. lead. smoke. etc. All these pollutants makes the atmosphere unhealthy as some of them are mutagenic and carcinogenic. The antiquated methods employed for removal and disposal of sewage and waste-water create serious problems of water pollution and water-borne diseases like typhoid. cholera. dysentery

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Dept of Chemistry, D.N. College, Meerut, India etc. In an over-crowded city, the rapid increase in the uses of loud-speakers, vehicular sirens, spectacular weddings and religious celebrations, social and political conferences, demonstrations create noise pollution which have audiological, biological and behavioural effects on people. In urban areas man's relationship with nature gets lost- much to man's own peril.

Urban Youth

Urban youth face maximum of constraints at home, in school/colleges and the education system: not enough accommodation for study and privacy in the house, not sufficient playgrounds attached to educational institutes, and for maximum part of the day imprisoned in crowded classrooms. The system does not provide direct experience of environment and people. Therefore, environmental education should be a necessary part of the present system for the youth- both urban and rural.

YOUTH AND ENVIRONMENTAL EDUCATION

A major constraint on the implementation of conservation measures is a lack of trained personnel. So, environmental training and education for youths is the demand of time. It is the fact that biological and physical features constitute the natural basis of the human environment. Its ethical, social, cultural and economic dimensions also play their part in determining the lines of approach whereby people may understand and make better use of natural resources in satisfying their needs. Environmental education is the result of reorientation of different disciplines and educational experiences which facilitate an integratel perception of the problems of the environment. The main aim lies in making individuals and communities to understand the complex nature of natural and built environments resulting from the interaction of their biological, physical, social, economic and cultural aspects and acquire the knowledge, values, attitude and practical skills to participate in a responsible, effective way to solve environmental problems. Environmental education should bring about a closer link between educational processes and real life.

Both the urban and rural youth are suggested to take part in the environmental programmes. They should meet in the form of "Environmental clubs". These proposed "Environmental clubs" should be organised at local levels and should be linked with national and international groups which are actively engaged in solving environmental problems.

Objectives of Proposed Rural Environmental Clubs

The proposed clubs shall have the following objectives:

1. To help social groups and individuals acquire an awareness and responsibility to the total environment and its allied problems through poster exhibitions, lectures, etc.

2. To encourage young people to study the environmental issues at the local, national and international levels.

3. To arrange and to participate in workshops, symposia, and seminars and to have field programmes.

4. To publish appeals, newsletter, bulletins etc., whenever necessary and possible.

5. To maintain a close link and actively cooperate with organisations, national and international, governmental and non-governmental, working for environmental studies and conservation.

6. To help social groups and individuals acquire a set of values and feeling of concern for the environment and the motivation for active participation in its improvement and protection.

Benefits from Participation of Rural Youth

The participation of rual youth in the environmental programmes in the form of proposed 'Rural Environmental clubs' will be valuable in the following terms:

a. More information is acquired about local needs, problems, capabilities and experience as effective planning and implementation require specific information of the sort only local people can provide efficiently.

b. Better plans can be made that are more realistic about what is possible, what will be done and what suits actual conditions best.

c. Maximum possible use of local resources, labour and funds as well as land and material.

d. Talent for management and administration can be developed in the rural sector to complement that of the government.

e. Maintenance of investments in roads, canals, buildings and other facilities is better where the local people have been consulted and involved in their creation.

The need for environmental education is continuous because each new generation needs to learn for itself the importance of conservation. The proposed Environmental clubs are to be established to coordinate existing organisations.

CONCLUSIONS

The above discussion shows that there is an urgent need to create awareness among the youths. Youths should meet together under the roof of proposed "Rural Environmental Clubs" to fight environmental problems boldly and effectively. The proposed organisations will help the government in making better plans, acquiring more information and better opportunities to use local resources.

YOUTH IN SERVICE OF ENVIRONMENT

Nagarjuna Velaga*

A comprehensive view of the environment has taken a long time to develop. It was foreshadowed in the works of early Greek scientific philosophers some 24 centuries ago, various combinations of such basic elements as earth, air, fire and water. Interestingly, if we take "fire" to signify energy, we have here four elemental components that enter into today's environmental concerns. Twentytwo centuries ago, Indian Emperor Ashoka (reigned 265-238 B.C.) defined a king's duty as not merely to protect citizens and punish wrong doers, but also to preserve animal life and forest trees. He also forbade the killing of a large number of species of animals for sport or food. Similarly, many Indian societies in North America have always believed in and lived out the environmental ethic.

In more recent times a comprehensive view of the environment has been taken by certain geographers such as Scot, Patrick Geddes in the late 19th century. It was the Austrian geographer Edward Scess who, in 1875, introduced the term 'Biosphere' and the concept was systematically developed by the Soviet biogeochemist, V.I. Vernadsky in the early part of this century. Conservation movements have contributed to awareness of the environment as a combination of dynamic forces in stable equilibrium. Some 150 years ago Simon Bolivar issued a decree on conservation and thus became the first conservationist in South America. Alexander Graham Bell foresaw today's fossil fuel depletion problems as early as the first quarter of this century.

As young people account for more than half of the world population, it goes without saying that it is of paramount importance to arouse their interest in nature conservation. This is no doubt the most effective way of bringing about the change in mentally essential to maintaining diversity in the biosphere and an overall ecological balance while ensuring in the long term attitude of individual and collective responsibility for the natural environment.

In developing a national youth policy, environmental aspects of youth development such as the role of youth in the protection and preservation of nature, the mobilisation of the exuberant energy of youth in community services to improve the environment; should be taken into account in the productive use of leisure time for enhancing the quality of life. The environmental aspects of national youth policies should include activities such as tree

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Internat. Stamp Collectors Assoc., Fatehnagar, Hyderabad, India planting campaigns to combat deforestation, desertification and soil erosion; environmental health support activities for primary health care; rehabilitation of urban slums and creation of recreation facilities. A policy on the needs and role of youth within the national health development policy should be formulated as a part of the national youth policy. A study of particular health needs (physical and psychological) of adolescents should be under taken in each country. The study should take into account different situations of the various categories of youth and the factors which may affect both their physical and mental health.

Particular attention should be paid to providing pure drinking water for the rural areas. Youth and youth organizations should be encouraged to contribute their efforts to project to meet the specific needs.

In consideration of the deterioration and degradation of the environment and as an effective and economic means of enabling wide participation of young people, governments and non-governmental organizations are strongly encouraged to launch a campaign for tree-planting. Citizens across the globe use the occasion of the International Youth Year 1985 for increasing the awareness and involvement of youth in activities for the protection and enhancement of the environment. If goals are global, youth involves the planting 1000 million trees throughout 1985 or the equivalent of one tree for every youth in the world.

Schemes should be devised, in cooperation with relevant government departments, youth, women and voluntary organizations to encourage the mass participation of young people in the promotion of primary health care in their community. Similar schemes should also be devised for youth participation in environmental protection activities (environmental sanitation, tree planting, etc.).

The challenge is formidable and unfortunately it has so far only partially been taken up by the teaching profession, notwithstanding the growing share taken by environmental education in school curriculum. Admittedly, formal education plays a necessary and specific role in the field but it does very little to exploit the immense potential for immediate action, disinterested enthusiasm and direct participation to be focused among young people. Children possess an innate curiosity for everything around them and it is therefore simple to stimulate their interest in nature. But can this be fully achieved by lessons in natural sciences, or even ecology, mainly dispensed in an artificial class-room environment. Young people are only too ready to demonstrate their initiative in creativeness by protecting nature in practical ways. Do our school really offer them the chance to do so?

ENVIRONMENTAL PLANNING FOR ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Alan M. Schwartz*

My task today is to use the 1980 Lake Placid Winter Olympic Games as an example of a large scale project in a framework of ecologically sustainable development. Perhaps some of the most compelling questions regarding development namely,should development occur at all, how much development should take place, and how the benefits of development should be distributed among individuals affected by it, will not be addressed in this paper. Rather, a specific project will be examined with an eye towards learning something about the environmental planning process that enabled this development to minimize its impact on the local environment. Failures of the process to deal with some questions will also be discussed.

Lake Placid, New York, nestled in the heart of the Adirondack Mountains is certainly not the typical olympic site. No other olympic site can be compared with Lake Placid. Lake Placid is smaller and less developed than any site to ever hold such an involved sporting event. The only essential ingredients necessary to host a winter olypmics that were in excess were determination and enthusiasm. This town of 2900 people, located in a fragile, unique environment for the northeast was able to incorporate an olympic games into the area with a great deal of forethought and advance environmental planning.

The planners of the 1980 Winter Olympic Games followed a several step environmental agenda to help ensure the Games compatability with the environment. They did this, not only because of their desire to have an ecologically compatible winter olympics, but because a lack of environmental planning could have meant the termination of the games at this site. It took only a handful of individuals, convinced that the 1976 Winter Olympics would be an environmental catastrophe for Colorado, to form a broad-based coalition which eliminated the olympic games from that region. This poorly financed group of olympic foes, calling themselves Citizens for Colorado's Future, mustered thousands of hours of volunteer support and 77,000 signatures on a petition to force the issue onto a state ballot. This grassroot environmental movement was victorious over the local and state chambers of commerce and the Denver Olympic Committee. The most convincing arguments they mustered centered on the negative effects of induced growth that would follow the games and the fact the major gains would be made by hotel executives, promoters and businessmen, while all the negative effects would be a burden to the citizens of the area for many years to come. The Lake Placid organizers, well aware of this potential threat, incorporated environmental planning into the total planning process at the earliest level after the decision to proceed with the games was made. The planners did this because they knew that the dhate over landuse controls within the adirondacks had already led to the creation of strong environmental groups that could derail the olympic planning process should it be perceived that the unique wilderness qualities of the adirondacks would be threatened. One of the first steps in the Olympic planning process, therefore, was for the local planners, The Lake Placid Organizing Committee (LPOOC) toi establish an environmental council. This council, headed by a lifelong Lake Placid resident, Vern Lamb, attempted to form a coalition of all interested environmental organizations in the state. The main function of the group was to advise the LPOOC of what environmental problems might arise and what mitigating measures might be incorporated into the Olympic planning process to protect the environment. This group was also charged to work with a consultant in the completion of a Draft Environmental Impact Statement which was required by the Federal National Environmental Policy Act, the prerequisite for federal funds. Perhaps the most important and understated role of this environmental council was to assure the LPOOC that representatives of environmental groups would be involved in dialogue with the committee and the environmentalists on the council were convinced their representative groups and environmental concerns were indeed being incorporated into the planning process. The LPOOC deemed it essential that any rumors or speculation of significant environmental degradation be nipped in the bud. The one thing that an incredibly tight olympic planning process could not tolerate, especially in a region with such a short construction period, was environmental litigation.

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A second major contributing fact to the success of the environmental planning process was the hiring of local experts who were first-rate in their field. Two of the region's finest environmental lawyers who had for years represented environmental groups, were hired by the olympic organizers to work with them in the environmental planning aspects of the games. Also, a first-rate environmental consultant was hired to prepare the environmental impact statement. This consultant's past environmental assessment efforts were criticaly reviewed in order to find a consultant who did not whitewash environmental issues, but rather addressed them head on and effectively.

The Environmental Council's activities at first centered upon the documented title "The Draft Environmental Impact Statement for the 1980 Winter Olympic Games." This document, prepared by a private consultant, was over six inches thick and contained information about every site and potential impacts for every activity associated with the games. Although an impressive document, it was not without its shortcomings. First, like all environmental impact statements, it tended to be rather general, and thus was not much help in dealing with specific problems that could arise at a specific site. Elements of transportation planning were especially poorly developed. Specific impacts and mitigation measures were rather well developed in the statement; however, real alternatives for specific venues and a true consideration of no development at all were virltualy ignored in the statement. This resulted in the paradox of an excellent environmental impact statement which from its inception could never realy comply with the goals of the national Environmental Policy Act, specifically incorporating environmental values into the decision as to whether or not a project should be developed. Because there were so many construction sites, and the games so complex, the assessment was a two level assessment: a site-specific assessment of each proposed activity coupled with an overall assessment of the total impacts of the olympic program.

The completion of the draft environmental impact statement led to the third very important aspect in the environmental planning process, namely, citizen input. The draft EIS was circulated and many individuals and groups had a chance to incorporate their views into a final environmental impact statement. Although some criticized this process as time consuming and expensive, important concerns surfaced that led to mitigation measures that eased the environmental impacts of the proposed development. Perhaps the most important concern that surfaced was the fact that mitigation measures were truly being incorporated into the final plans. Although mitigation measures have been part of environmental impact statements for as long as these statments have been in existence, often the implementation phase of the project has not incorporated potential mitigation measures discussed in the environmental assessment. Agencies as well as individuals responding to the draft environmental impact statement stated that there should be guarantees that mitigation measures discussed in the statement would be incorporated in the final process. In order to meet this goal, the Economic Development Administration (EDA), the agency in charge of the federal funding for the olympic games, specified that environmental monitors be hired to check on all construction work on a continuing basis. The monitors reports would be filed with the NewYork State Department of Environmental Conservation and be availabele for public scrutiny. This was not merely a public relations move; the monitors would be sufficient in number and empowered to stop construction or withold funds from any contractor not meeting environmental mitigation measures that were discussed in the final impact statement. This power was invoked when a siltation problem ensued on a construction site for the olympic village and was not corrected in as reasonable amount of time.

A second major concern expressed in regard to the draft environmental impact statement was the tentative and preliminary nature of the transportation planning. This is one element of the total planning process that was not improved very much in the final environmental impact statement and resulted in significant problems at the beginning of the olympic games. Another major and unusual asset of this planning process was that the impacts were predicted on a given number of persons in attendance. Therefore, agencies that had power to fund the games could insist that the total ticket sales not exceed the number for which the impacts were predicted. This number (50,000 persons/day) was the upper limit during the 12 days of the winter olympic games. It is quite unusual, however, that agencies have this kind of power. Other impacts associated with specific venues that were not covered in the draft EIS were reasonably dealt with by environmental monitors and resulted in games more compatible with the environmental setting. The media center, originally scheduled to be constructed in the floodplain of Chubb Creek, was moved after opposition was raised to the location of the building in the draft environmental impact statement.

Thus, most major site specific impacts were minimized by a environmental planning process which incorporated draft and final environmental impact statements, first-rate consultants and citizen input. However, several problems that arose despite the environmental planning process are worth examining as they point out certain flaws that occur whenever site specific impacts are considered and larger, more general environmental problems ignored or minimized. One of the most significant site specific environmental impact of the games was the erosion that took place after 40 acres of pines were clearcut from an area and left exposed during construction. This site of the olympic village washed away after two severe rainstorms. Although the environmental impact statement discussed this potential, the olympic planners did not have control over this site. In this particular case, the Federal Bureau of Prisons, who will be taking over the olympic village after the games, were incharge of construction and, therefore, specific environmental mitigation measures could not be incorporated into their planning process. This points out a general problem of where a specific construction project has impacts beyond the site itself and, more importantly perhaps, has impacts that the proponent of the development do not have control over.

Another major problem that falls in the same general category is that every major construction activity on the scale of an olympic game brings with it secondary impacts and induced growth. The people who do the planning for a specific project (in this case the olympics) almost never have control over the "secondary impacts and the induced grwoth." One only has to visit a national park to realize that immediately outside a protected area, large scale development which is often incompatible with the pristine park, springs up at its borders. Lake Placid was in the unusual position of having surrounding landuse controlled by the Adirondack Park Agency that administers perhaps the strictest private landuse control plan in the United States. Thus, major induced growth impacts that were feared in Denver, never materialized in the Adirondacks because of this unusual regulatory agency. Changes in the Lake Placid community, although outside the jurisdiction of this agency, are up to the people of the village of Lake Placid and thus also not influenced by the olympic planners.

Thus, when one views the entire planning process, the Lake Placid Olympics presents us with an interesting although somewhat unique example. First, major environmental impacts were minimized by the necessity of draft and final impact statements, the creation of an environmental council that incorporated environmental values into the very beginning of the planning process, top quality experts hired early in the planning process, and the inclusion of environmental monitors with legal power to oversee mitigation measures. In this way, temporary impacts and site specific impacts were truly minimized and the olympic games were held without major environmental problems. Induced growth, which often is the largest and most difficult problem to deal with, in this case was regulated by a separate agency. In most cases one must ask the question, who will deal with the induced growth and secondary impacts when projects get as large as an olympic games. Lastly, problems that did arise seemed to be related to the fact that the people who planned the games, had no control over specific problem areas. This is something that always will occur and thus any large-scale project that is to be built with an eye toward ecologically sustainable development should be defined in broadest terms, and all aspects of potential environmental problems, even if they fall outside the jurisdiction of the planning agency, must be considered. This obviously points to large interdisciplinary planning efforts as a cornerstone of ecologically sustainable development.

FROM ECOLOGICAL PHENOMENA TO ENVIRONMENTAL EDUCATION

Gerhard Trommer*

INTRODUCTION

In historical development of education it is a proven tradition, started by F. Bacon (1561-1626) and Comenius (1592-1670), to learn nature by getting evidence about concrete phenomena. Since that time it is a maxim to study, what is in your eyes, ears and so forth. But nevertheless since tnose old days there still works another tradition: to learn nature from models, pictures, slides, films, books or stories, because that might be easier, more reasonable and more effective.

Environmental education has to consider both. On one hand, sensitive contacts with phenomena must avoid feeling strange to nature. But on the other hand, there is a lot of knowledge one cannot find only by keeping eyes, ears, nose and hands open. Have you ever seen, have you ever smelt, or did you watch ecological equilibrium at any time? Terms like ecological equilibrium depend on knowledge as results of secondary experience of science and as results of well documented stages of natural process. But it is also remarkable, that facts were mentioned by men. So it will be important to care about men's labour in social and natural environment.

In industrial, developed, densely popoulated countries we find many exaples to show men being in gear with nature. Only few workmen with big machines are able to dredge out gravel-lakes in a very short time. They are able to change meadows into waste areas covered with muddy water, silt and gravel. Gravel-lakes are rather typical marks in our landscapes, lying beside asphalted highways and concrete settlements. These artificial lakes are young, unripe ecosystems, in which the process of natural succession has just started to an uncertain climax somewhere in the future. This may be a good opportunity to learn how nature works. Exactly a hundred years ago, Junge (1885) published his famous ecological work for Biology in German Volksscchule which he called "Der Dorfteich als Lebensgemeinschaft" (The village pond as biocoenosis). But today in the highly civilised landscapes perhaps one will not find many ponds but may be fresh dredged gravellakes. We can study here how men use them for recreational activities, and between succeeding nature and men's interests civil authorities are planning how to use these lakes further.

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GRAVEL LAKE SITUATION

I have watched a gravellake near Autobahn A-39 situated near Wolfsburg in the Schunter valley in lower Saxony from its beginning. I live in the village Flechtorf about 300 m west from the banks of the gravellake. Gravel had been dredged out of the pasture meadows to build the dam for the highway.

After the springtime dredging and planning thearea came to an end in 1982, I decided to use it for setting an environmental education course with the students who wanted to become biology terachers. I had the idea to create a project but I still had no experience, no definite curriculum outline and no definite aims. I had a pattern: B. Blume (1981) had succeeded with his pupils in preserving bank areas of the lake Einfelder See for nature. My course started with 8 students, going once a week to the gravellake to study how nature was working in a wasted area.

The Field Course as a Project

First the students interest was to study how nature works. They solved problems of mapping the area, soil planing by caterpillars, types of erosions, overflowing of river Schunter, plants growing in the pioneer vegetation, silt movement by wind and waves, and kinds of animals resting at the lake. The students did not care much for the human activities because in the rather cold April days only a few village people walked down to the lake and led their dogs.

One day, on finding the eggs destroyed in a nest of Charadrius dubius, the students were forced to preserve nature and take care of men 's interest for the lake. We also decided to try protecting nature and after discussions a plan was worked out which covered the interests of village people to walk along the lake and the nature preservation by marking some areas forbidden for vacation activity. The plan was given to the civic authorities who stopped most vacation activities like car driving to lake shores, bathing swimming and boating, in summer 1982 by setting up sign posts. In 1983, very little disturbance from such activities was registered. In wintertime, two students involved in gaining some teaching experience at a secondary school, developed lessons for the study of animals at the gravellake. The children (aged around 11 years) learned ecological adaptations of birds and also how to behave with the birds.

In the spring of 1983, another group of students decided to watch nature from certain selected regions. Some students watched nesting birds who made nests at the gravel lake for the first time as they needed reed banks which had grown in summer 1982. Other students looked fopr plant strategies, how they spread out their rhizomes into flat banks, and what animals werre grazing reed. All of them discussed together to get in touch with village people and decided to organise an exhibition.

During winter, two students worked out an exhibition which was opened in the community hall of Flechtorf in December 1983. More than 300 students visited it with their teachers.

In 1984 no student worked in the gravellake project but some people in the village showed interest in the Project. The following activities were undertaken:

More than 15 small pools and puddles were dredged out for amphibia. A planed plantless gravel field was settled for nests of Charadrius dubius. All nature preservation areas were fenced. A bridge is to be built over river Schunter so that village people can use a new circuit trail along the non-fenced banks of the lake down the river to the village.

During spring 1985, another group of students proposes to study the gravellake especially the established biotopes, and we hope to have better contacts with the village people.

Mapping Gravellake Area

Before our project, there was no survey of the area made by Amt fär Agrarstruktur, the most important civic authority for planning gravellakes and their use. This authority had also to compensate the farmers for the lost land by land-exchange (Flurbereinigung) or money. The new law of land exchange took care of biotope management and therefore we worked closely with this authority.

During May 1982 we got a map (1:5000 scale) from Amt fär Agrarstruktur and divided it into a grid of squares. All our findings were recorded in the map (Figs 1-4). We learned of a plan of the company which had dredged out the gravellake. They wanted to bring in a mass of plants (grasses, reeds, bushes, trees) around the gravellake but it was not necessary as the nature works by itself and the Amt could save lot money on such efforts. In June we found most banks already covered with reeds and even young trees of Salix caprea and Salix fragilis, possibly planted by village people, grew up. We also placed arguments against the conmstruction of a road around the lake as it could get eroded away by the overflowing Schunter river.

Later we found indications of bad water quality (high N indicated by enormous growth of Glyceria maxima) caused by flooding of the lake from Schunter river. In the beginning, children did not heed our warning but bathing was stopped when mass death occurred of Gasterosteus aculeatus due to blue green algal blooms in warm days of July. Fish death was also an inducement to the Amt for setting up signposts warning against unauthorised vacation activities in the area. Later, at our request the health authorities (Medizinaluntersuchungsamt) confirmed the bad water quality and high coliform content of the water and declared it unfit for bathing.

Students Proposals for Nature Conservation

The Amt fàr Agrarstruktur invited proposals for deciding areas suitable for nature protection and those could be open for villagers. We invited a nature preservation expert who was a well known leader of nature preservation association Bund Umwelt und Naturschutz Deutschland e.V. We had no difficulty to compromise between nature preservation strategies but to find acceptable offer for people to walk along the lake. An official of the Amt fär agrarstruktur came up with the best idea of building a bridge touching the gravellake (Fig. 5). For nature preservation we looked out places for amphibia spawn ponds, nesting sites for birds and to plant trees and bushes to cover animals. All these plans were included in the plans of the Amt, and community accepted them.

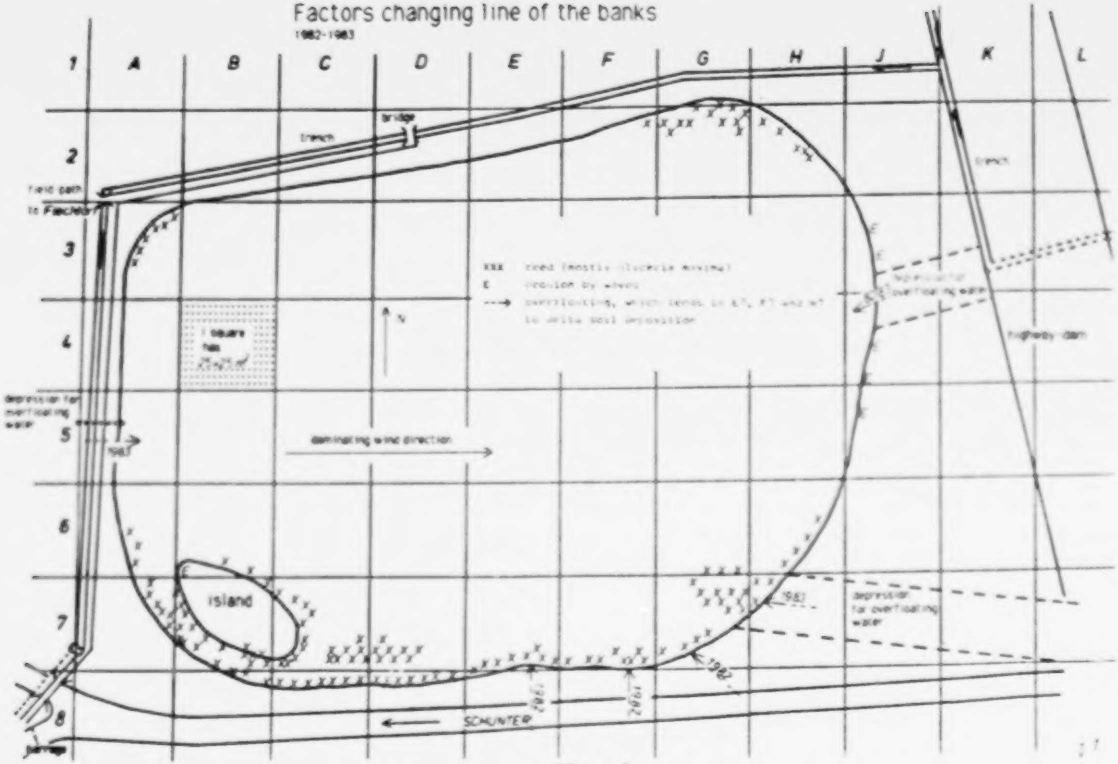
Acceptance of students proposals fed back much energy. The group worked intensively, some continuing in semester vacation. Students ained experience to communicate with village people, regional news reporters and especially with children groups in school when students planned lessons about animal adaptations to gravellake biotope.

Now the didactic aspet became important. In 1983 an exhibition about plant and animal succession at gravellake area was made and thus contacts were established with the capital community which gave money to support student activity and later the exhibition was arranged in village community hall. In this exhibition people could be active playing the gravellake game, making a learning rally through nature at gravellake and there was a vacation tree covered with notes what would happen to animals and plants if one gave space to vacation interest. The nature preservation aims were greatly appreciated and the newspapers also noted that. Only few elder people came to the exhibition possibly due to Christmas time.

CONCLUSIONS

Enquiries from students about the effects of the project gave positive impressions about learning plant and animal species in their ecological setting and knowlwedge how to act with authorities. It helped them finding practical ways for environmental edzucation outdoor classroom.

It must not be a gravelake situation for environmental education but other examples to see how nature works in wasted areas and how man's interests come in conflict with plant and animal life. The project gave teacher-students better educational ideas to watch nature work, and they also gained experiences on managing aspects of ecosystem development. This brings hopeful view in environmental education whch will help coming generation to find economic ways to include nature and avoid working against it.


Factors changing line of the banks
1982-1983
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D
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K
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3
4
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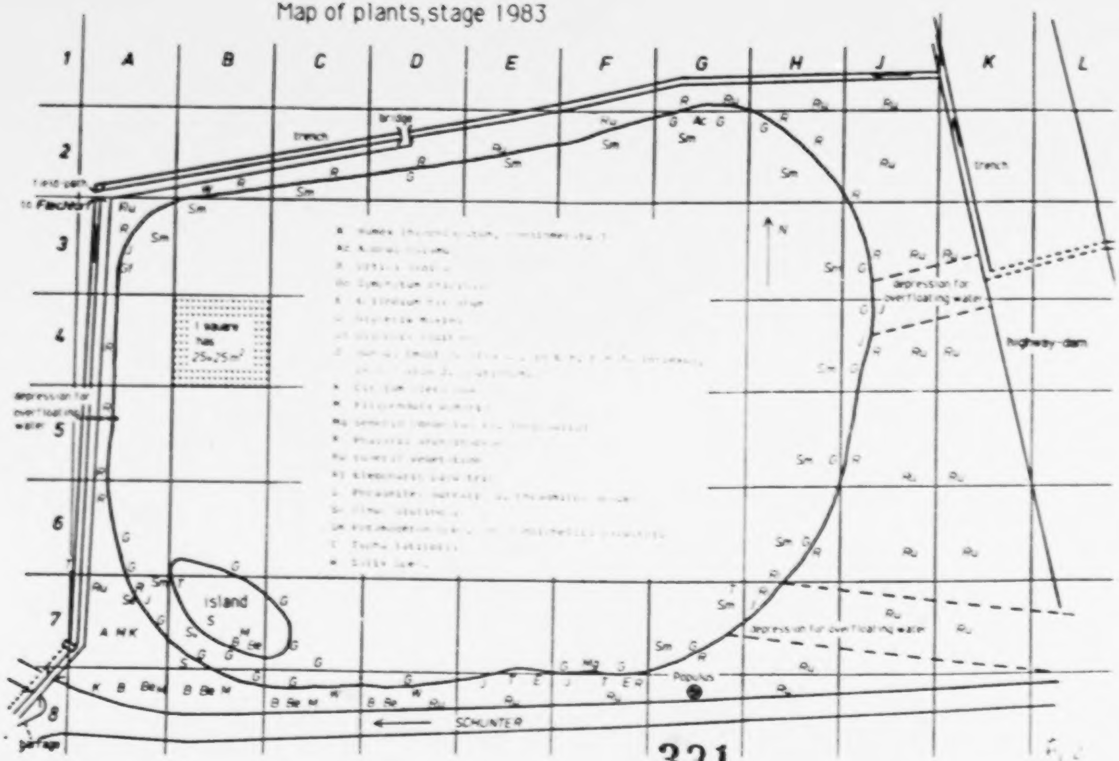
6
7
8
trench
bridge
field path to Fischer
xxx reed (mostly Glyceria maxima)
E erosion by waves
overflooding, which lends in K7, F7 and H7 to white soil deposition
depression for overfloating water
trench
highway dam
1 square has 25×25 m²
N
depression for overfloating water
1983
dominating wind direction
island
1983
depression for overfloating water
1982
1982
1982
SCHUNTER
barrage

Fig. 1.

Map of plants, stage 1983



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field path to Flechten
trench
bridge
trench
N
1 square has 25×25 m²
depression for overfloating water
depression for overfloating water
depression for overfloating water
highway-dam
island
Populus
SCHUNTER
garage
Ru
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S
W
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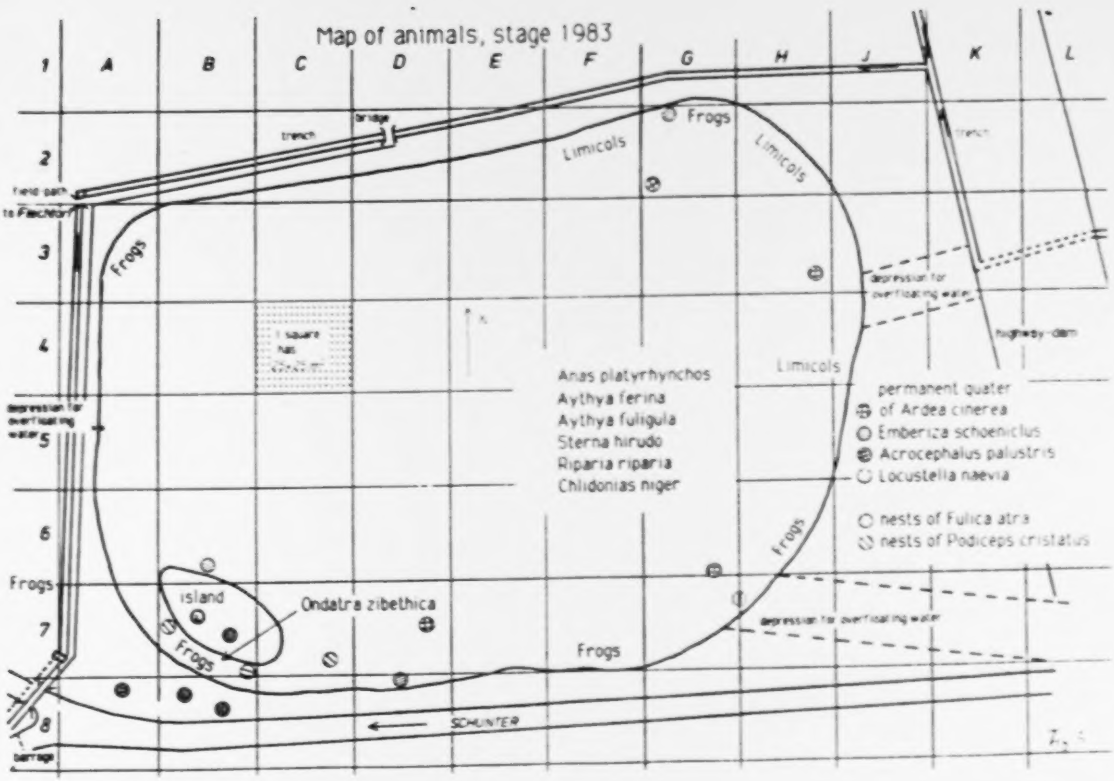
E
Mg
A

Fig. 2.


Map of animals, stage 1983
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7
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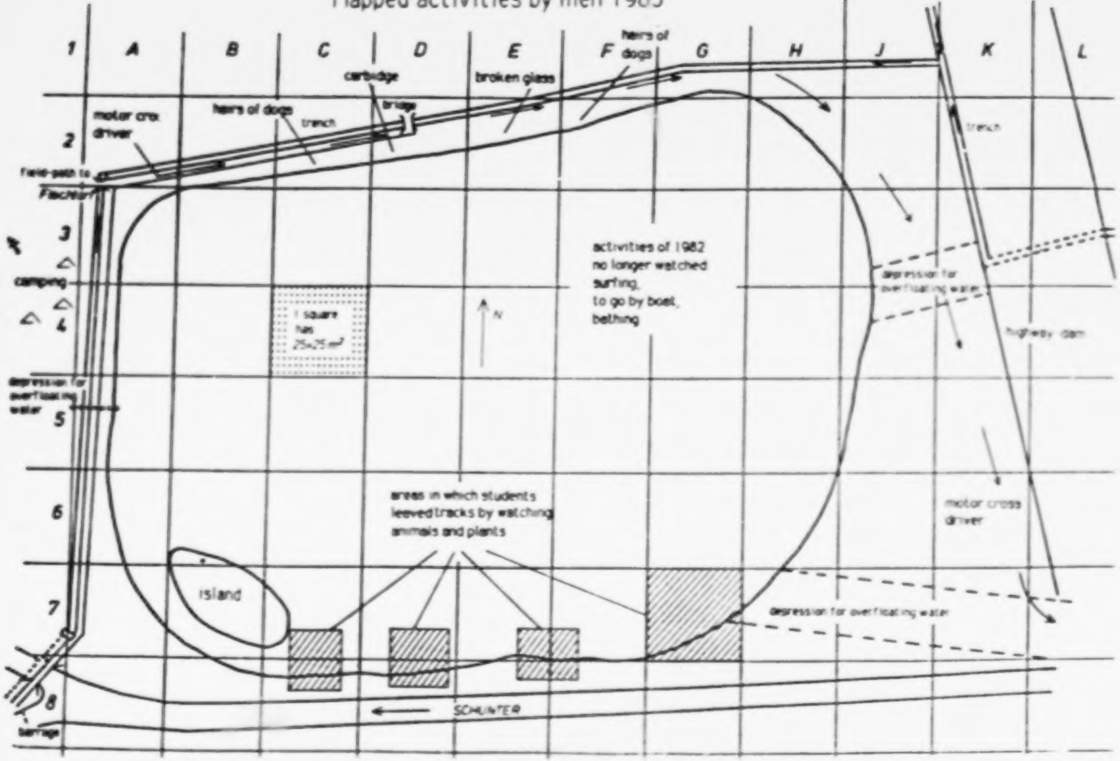
trench
bridge
field-path
to Flechtorf
Frogs
Limicols
Frogs
Limicols
trench
depression for overfloating water
highway-dam
1 square has 25 × 25 m²
N
depression for overfloating water
Limicols
Anas platyrhynchos
Aythya ferina
Aythya fuligula
Sterna hirudo
Riparia riparia
Chlidonias niger
permanent quater of Ardea cinerea
Emberiza schoeniclus
Acrocephalus palustris
Locustella naevia
nests of Fulica atra
nests of Podiceps cristatus
Frogs
Frogs
island
Ondatra zibethica
Frogs
Frogs
depression for overfloating water
SCHUNTER
barrage

Fig. 3.

Mapped activities by men 1983


1
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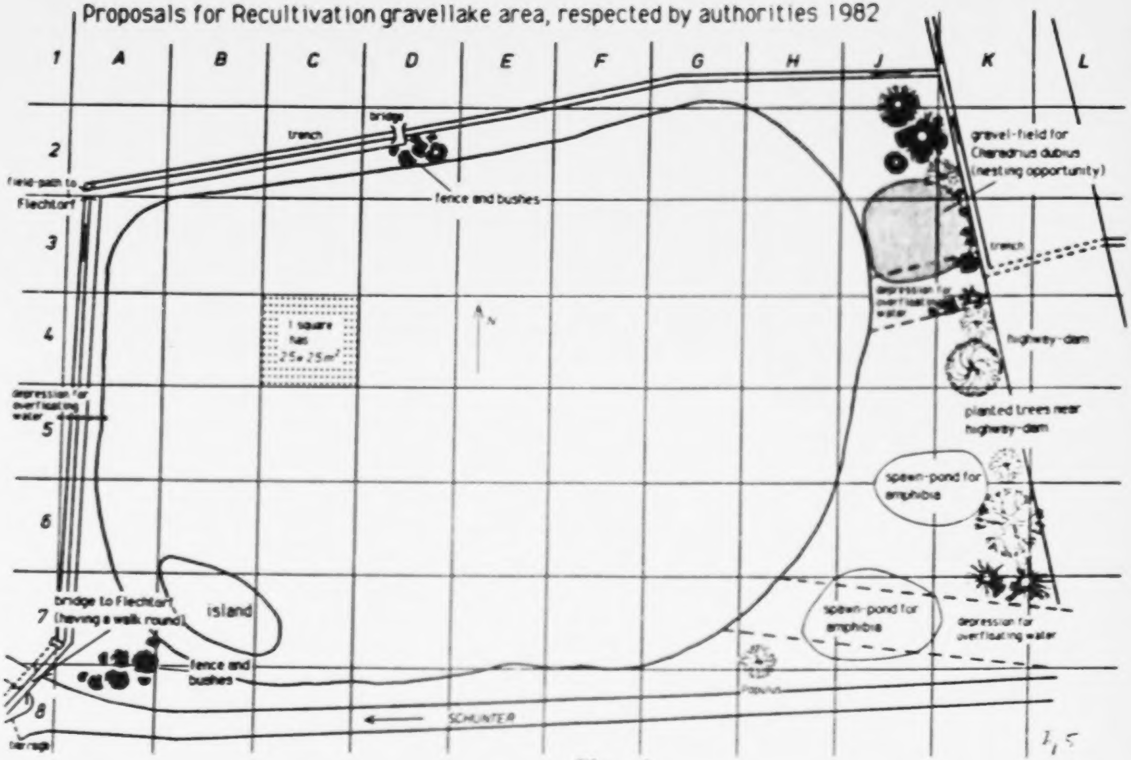
7
8
motor cross driver
hairs of dogs
trench
carbridge
bridge
broken glass
hairs of dogs
field-path to Flechtorf
camping
trench
activities of 1982
no longer watched
surfing,
to go by boat,
bathing
1 square has 25x25 m²
N
depression for overfloating water
highway dam
depression for overfloating water
motor cross driver
areas in which students leaved tracks by watching animals and plants
island
depression for overfloating water
SCHUNTER
barrage

Fig. 4


Proposals for Recultivation gravellake area, respected by authorities 1982

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K
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4
5
6
7
8
trench
bridge
field-path to Flechtorf
fence and bushes
1 square has 25×25 m²
N
depression for overfloating water
gravel-field for Charadrius dubius (nesting opportunity)
trench
depression for overfloating water
highway-dam
planted trees near highway-dam
spawn-pond for amphibia
spawn-pond for amphibia
depression for overfloating water
island
bridge to Flechtorf (having a walk round)
fence and bushes
Populus
SCHUNTER
barrage
1,5

Fig. 5.

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TENNESSEE VALLEY AUTHORITY: A MODEL FOR COOPERATION ENVIRONMENTAL EDUCATION

John Judy*

The Tennessee Valley Authority (TVA) is a federal agency of the United States Government with responsibilty of developing and managing both human and natural resources within the Tennessee River Valley. TVA serves an area within the southeastern United States made up of parts of seven states- Tennessee, Alabama, Mississippi, Kentucky, Virginia, North Carolina and Georgia. It includes the watershed of the Tennessee river system and surrounding Territory served with TVA power. The area contains 91,000 square miles with a 1980 population of 7.8 million people equivalent in size to Great Britain. TVA is an independent agency of the Federal Government created by an act of the US Congress in 1933. In asking Congress to create TVA, President Roosevelt called for "a corporation clothed with the power of government but possessed with the flexibility and initiative of a private enterprise". TVA is headed by a 3-member Board of Directors appointed by the President of the United States and confirmed by the US Senate. The president designates a chairman from among the three directors.

TVA has received world wide recognition for its system of multiple-purpose dams that provide flood control, navigation, electric power production, recreation and water supply. The total power system includes 29 hydroelectric plants, 12 coal-fired steam plants, 2 nuclear plants, one hydroelectric pumped storage plant and four combustion turbine plants. The power system is self-sustaining. Revenues from the sale of power cover all costs of operating and maintaining the system: however, power customers do not pay for TVA s new power programs such as fertilizer development, economic development and natural resource programs.

Within the TVA office of Natural Resources and Economic Development is the Environmental/Energy Program. This educational program is a regional effort in the southeastern United States. The TVA program is supportive of many of the recommendations of the Intergovernmental conference on Environmental Education held in 1977 in Tbilisi (USSR). Broad program objectives of TVA in environmental education are to:

1. improve the quality of life, environment and environmentally oriented education in the Tennessee valley region.
2. assist in the development of attitudes, values and lifestyles that are inherent in a quality environment,

3. provide learning experiences that directly involve people in identifying and solving real community environmental problems.
4. assist in the develpment of a citizenry that has a basic understanding of human relationships and interactions with the total environment, understands the need for maintaining ecological balance; is aware, concerned and motivated to work on solutions to environmental problems, and is individually comitted to improving the environment.
5. provide information about the environment and its associated problems to the citizenry so they can make the best possible decisions on the utilization of resources.

To implement these objectives both formal and nonformal programming are necessary. Essentially the formal programs are targeted toward the elementary, secondary and higher education entities. The nonformal programs are those in which individuals participate within their own discretionary timeframe. To further expand upon the objectives, TVA has made some basic assumptions underlying its approach to environmental education:

1. Environental education includes both formal and nonformal education.
2. Environmental education is a process-oriented approach and is aimed at assisting the learner in becoming informed and in learning how to be effective in solving and preventing the full-range of environmental problems.
3. Environmental education is interdisciplinary in approach.
4. Environmental education is aimed at motivating the individual to act upon his environmental concerns.
5. Environmental education is concerned about the social implications of environmental decisions.
6. Environmental education is directed toward helping individuals become knowledgeable concerning the total environment (natural and manmade) and associated problems (physical, social, economic, political and cultural).
7. Environmental education is directed toward increasing the learner's interest in, awareness of and sesitivity towards the environment.

The preceding delineation serves as a functional framework for environmental/energy education as implemented by TVA. Primary targets for TVA's program are the citizens within the Tennessee Valley region; however, since one purpose is to provide exemplary programs for the nation, TVA services may be broad ranging and not restricted to any one geographical ara. Selected inputs of TVA into the develpment of programs depend upon the type of program, formal or non-formal.

A. Within the formal education program, TVA seeks to:

1. provide professional assistance consisting of technical information, leadership and continuing liasion to bring about

a self-sufficient program for the sponsoring entity.
2. provide facility development assistance to schools and organisations in the development of outdoor and indoor facilities for environmental education.
3. provide needs assessment assistance to local schools and organisations in assesing environmental concerns preparatory to program development.
4. provide site analysis assistance to schools in analysing potential sites for outdoor classrooms, laboratories, interpretive trails and study sites based on the feasibility of the site, suggested uses and long range utilization.
5. provide assistance in identifying and obtaining materials for material resource centers on local and regional levels and specific materials suitable for classroom use.
6. provide assistance with in-service programs designed to instruct teachers in the technique and philosophy of environmental education including such activities as problem solving seminars, instrumentation workshops, field activities and orientation role simulation sessions and environmental awareness programs.
7. provide continuing education assistance to environmental education centers and universities in the development and implementation of course work for teachers in environmental education.

B. Within the nonformal education program, TVA seeks to.

1. provide assistance with adult and continuing education through cooperative efforts with colleges and universities in program design and implementation.
2. participate in cooperative programming with social, state and federal organisations, serice and civic groups, and the private sector to produce programming and materials for nonformal entities.
3. participate in or develop community education seminars relating to educational and environmental concerns on the local level.
4. develop TVA land and facilities for access and use by the public as participants in nonformal environmental education activities.

Although the preceding are the major areas of emphasis, special demonstrations designed to identify and test innovative techniques and processes are also frequently supported by TVA s environmental education effort. The major demonstration area is 170,000 acre site, Land Between the Lakes (LBL), located in the states of Kentucky anmd Tennessee. Executive approval in 1963 by President John F. Kennedy initiated this national demonstration area. The two major themes and areas of demonstration were to be outdoor recreation and environmental education. Until the early

1970s. TVA s environmental education program had been centered primarily on LBL. With increased interest in environmental education, TVA received more requests for assistance. To eliminate duplication of efforts and to provide coordination a TVA Advisory Council for Environmental Education was formed. The membership consisted of managers of programs with environmental educationm activities. The Council made the decision to establish a regional Environmental Education program. The program would assume responsibility for environmental education within the Tennessee Valley region. From the valley-wide perspective of environmental education, two major program components were established. One component, the formal education project was designed to systematically develop a network of environmental education centers to work with school systems and universities. The other component, the nonformal education project, was designed to coordinate the development of TVA lands and facilities, and develop programs for the non-school population.

The formal education project has rsulted in the establishment of 10 university centers for environmental/energy education activities. It should be noted that energy education was added to the program title during the 1970s to reflect the concern over energy resources. In the establishment of the centers, TVA funds are matched by the University. TVA funds are generally committed on a reducing basis over a 5-year period. As TVA funds are reduced, university contributions are increased, allowing the average budget to be maintained. The centers are designed to become self-sustaining and to continue to provide educational services after TVA funding to the center ends. Matching funds from the University, TVA s reduction in funds and the self-sustaining objective of the center result in cost-effective operations.

Each center has unique program development and delivery capability because of these different characteristics, additional funds are located with both private and governmental sources. The combination of Federal, State, private business and citizen group support adds financial support to the centers and is also significant in broadening the base of groups that endorse environmental and energy programs. There is a ratio of 4:1 on the average on center and TVA funds. Cost effectiveness is also measured in a multiplier effect that with the investment of teacher training, allows one teacher trained at a center activity to impact many students. Approx. 15,000 teachers have engaged in environmental/energy education since the beginning of the network strategy.

It is estimated that those teachers will teach 1.1 million student-days of environmental and energy education annually. Teachers receive several services through the respective centers. These services include:

Teacher Training, including the upgrading of existing teachers and offering training to University students intent on education as a profession.

Regional Service, including a clearinghouse function for information on key issues and concerns, individual assistance to citizen groups and organisations, and work with specific schools in the region.

Program Development, including energy, agriculture and natural resopurce themes as well as programs designed to strengthen the basic skills initially focussing on science and maths.

Research, including practical review and testing of curricula, demographic and distribution studies for program delivery and needs and resource inventories on Valley counties.

It is projected that by 1990 there will be 16 University based centers. These centers will have provided training to 30,000 teachers, completed 70 educational programs conducted 50 research projects and provided outreach to over 300 community groups and organizations.

The Nonformal Education project provides two approaches to environmental/energy education. First interpretive exhibits and programs are provided at selected TVA lands and facilities. Creative exhibits and active public programming make TVA lands and facilities "living laboratories" and provide the public with the opportunity for environmental and energy learning as well as broadening understanding of TVA and its work. Many of these progerams and exhibits address themes of natural resource management, energy conservation and natural history.

The second approach involves programs to the public rather than the public visiting a specific TVA facility. There are several citizens in the USA interested in resource conservation. One such group is the National Council of State Garden Clubs,Inc. There are approx. 10,000 garden club members in each state. TVA staff have conducted workshops on energy conservation and water quality with leaders in the 7-state Tennessee valley. The workshop participants are leaders within their respective states and are trained as leaders to conduct similar workshops in their local areas. Plans are now underway to conduct a similar workshop on wildlife resources.

Other special projects conducted by TVA staff in both formal and nonformal project areas include the development of activities in agriculture, energy conservation and global environmental concerns.

A course of study on Integrated Regional Resource Management has been developed based on the experience of the Tennessee Valley Authority. The course is desgnied for resource practitioners in developing countries with responsibilities in areas such as water resource management, agriculture, fertilizer and chemical development, forest and wildlife management, engineering design and construction, and regional economic and community development. Participants should have the ability to participate in discussions, exercises and projects conducted in English.

The course is designed to (a) illustrate the value of integrated resource management, (b) develop awareness, knowledge and skills necessary to formulate integrated resource development programs and projects, (c) analyze TVA s experience as a regional resource development organization, and (d) provide experience in applying integrated resource management concepts to the participants own situations.

Participants will (i) develop a knowledge of fundamental resource concepts, practices, tools and techniques, and their application in integrated resource development programs and projects, (ii) learn how to use a systematic process to plan, develop, implemet and evaluate integrated resource development of TVA and its impact in the Tennessee Valley region, and (iii) participate in practical exercises that apply integrated resources management concepts and skills.

Participants are encouraged to identify personal objectives within the course objectives, share their home country situation and adapt the course content to the realities they face. The format of the course facilitates this process by providing small work groups, introducing case studies and case exercises, arranging field trips, and requesting involvement of all participants in an ongoing evaluation process.

The course will be presented in the Tennesssee Valley region which provides opportunities to show how research and technology are used to develop the resources of the region. Instructors will include experienced TVA coordinators, managers and technical staff from a wide range of resource areas. Participants will also have the opportunity to interact with decision maklers and resource specialists outside TVA most of which have worked in partnership with the agency to develop resource programs and projects.

Modules range in length from two to eight days. Each module can be exapanded and offered separately to meet the needs of professionals seeking detailed knowledge and skills in a particular resource area. Even if offered separately the modules emphasize the need for managing in an integrated context.

A detailed workbook of resources and references will provide each participant information which they can use to initiate integrated resource managememt techniques in their home country.

In summary the course examines fundamental resource management concepts and the application of those concepts in managing integrated resource development programs and projects using TVA experience as a primary case study.It will explain the importance of the integrated regional resource management approach and how the results can exceed the sum of the efforts to manage resources independently.

ENVIRONMENTAL EDUCATION FOR THE BIOSPHERE: WORKSHOPS ON ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Jerry Berberet*

Environmental educators and scholars, and a scattering of other environmental professionals and students from ten countries and five continents participated during October 5-7, 1984, in a workshop to evaluate educational strategies for ecologically sustainable development. Held at the Chateau Lake Louise in Banff National Park, Alberta, the workshop involved intensive small group assessment of ecological and cultural imperatives which contribute to patterns of environmental exploitation as an economic resource. Insights gained from the analysis of economic, political, social and ecological factors in development formed the content for educational approaches and methods the workshop generated to improve the ability of both formal and citizen education to respond to crucial issues of biosphere survival.

Sponsored by the Environmental Studies, K-12 Education and Non-Formal Education Sections of the North American Association for Environmental Education (NAEE), the workshop inaugurated the annual conference of NAEE which met for the first time in Canada, October 7-9. The purpose and structure of the workshop was modelled after the International Workshop on Development and Biosphere Stability, held in New Delhi, June 1-5, 1984. The one-hundred participants from ten nations at the workshop in India focussed upon patterns and impacts of development in the developing Third World; the Lake Louise gathering emphasized the economic development-environmental protection interface in the more highly industrialized North American context. Both workshops related their respective regional analyses to the biogeochemical well being of the biosphere as a whole and the notion of protecting habitats as physical, biological and cultural ecosystems.

The New Delhi workshop, cosponsored by the Indian Environmental Society, the Indian Department of Environment, Indian Ministry of Education, the World Council for the Biosphere and the International Society for Environmental Education concluded that problems of deforestation, desertification, soil erosion and salinization of soils are environmental problems first and foremost because they threaten the ability of developing countries to feed themselves. Facing high rates of population growth and low per capita income, Third World nations place higher priority upon ecomnomic development than environmental quality. Alarmed by the increasing magnitude of environmental problems, however, especially those caused by population pressures, concern is growing that effective environmental management must accompany economic advances.

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In addition to the recognition that steps are necessary to maintain the very existence of the environment as an economic resource, the New Delhi discussions revealed anxiety about the impact of economic development upon traditional cultural values and mores. Some saw the environmental movement as a way to shore up cherished elements of culture which transcend material aspects of human well being. The call was heard that developing countries should "reindustrialize" and "remodernize" in ways that avoid the disruption of values, family structure and community which have accompanied industrialization in the West. Maintenance of cultural diversity was seen as comparable in importance to the notion of ecological diversity. Preservation of traditional cultures which have sustained environments for millenia and values wehich stress conservationm and a land ethic were especially emphasized.

Environmental Education was seen as a vehicle to promote a balance whereby standards of living could be upgraded in a way compatible with imperatives of environment and culture. Workshop participants recommended establishment of a national environmental education center in India to provide research, teacher training and direction to the Indian EE movement. Educational efforts were seen as especially needed to reach into rural areas and to influence decision makers in Government, business and industry. In order to have biosphere-wide impact the workshop recommended that a global environmental education network be established to foster research, share information and improve communications on environmental matters.

The theme of the Lake Louise Workshop, "Education for the Biosphere: Thinking Globally, Acting Locally", invited participants to devise educational strategies that would move environmental education beyond the classroom to the larger community. In fact the Workshop inspired an activist mood which carried over in the NAEE conference and resulted in approval of the so-called "Banff Declaration", a call for a renewed environmental education movement on a global scale due to the decline in quality of life for vast numbers of people and contuinued deterioration of the global environment since the UN Stockholm conference in 1972. The Banff declaration noted that environmental education must be inserted at the center of the so-called "Back to Basics" movement in education in order to "endow learners with environmental competencies that will enable them to contribute to the resolution of local and global problems and to the development of an ecologically sustainable society". Further, the Declaration proposed the evolution of a new environmental ethic embracing "the whole of the natural order" and every aspect of education (see Appendix A)

Following the lead of the Banff Declaration, workshop participants adopted a series of recommendations to address resolution of local to global environmental problems more effectively. Specifically the group recommended development of a "Global Environmental Education Strategy" and establishment of a "World Environmental Education Fund" to support realization of the new environmental ethic called for in the Banff Declaration. The workshop also urged creation of a global environmental information network and widespread dissemination of advanced information technology. Finally the workshop urged increased efforts to develop environmental education programs in the major sectors of society beyond the schools (see Appendix B).

Although the New Delhi and Lake Louise workshops were structured similarly, differences in setting and backgrounds of participants presaged several contrasting outcomes. The Lake Louise workshop attempted to use the splendid setting of Banff National Park as a case study of a conscious attempt to limit development in systematically planned ways. Although the Lake Louise gathering took pains to consider development regionally and globally as well, the context of this workshop contrasted starkly with New Delhi s urban setting and the pressures upon the land everywhere in evidence in India. Contextually, the two workshops represented almost the extremes of priority upon economic development and environmental preservation which exist within the global environmental education community.

The professional background of participants in each workshop varied significantly, even though ten nations and several continents were represented in each. Most of the New Delhi participants were research scientists and social scientists or environmental officials from India. They tended to analyse ecological and cultural imperatives in detail and were largely inexperienced in developing effective educational strategies to communicate this knowledge in classroom and community. The Banff group, on the other hand, largely consisted of professional environmental educators from the highly developed West, notably Canada, Australia and the United States. The Lake Louise participants had mixed success in evaluating and relating ecological and cultural imperatives in depth, but were systematic and comprehensive in articulating the "Global Environmental Education Strategy".

Keynote speakers reviewed the New Delhi Workshop, described the Banff and other park planning and management processes, and introduced discussion of ecological, cultural and educational imperatives. Workshop co-Director, Arthur Sacks, curent NAEE President, outlined major conclusions and recommendations of the New Delhi gathering. Sacks remarks underscored the critical contributions of the humanities to environmental education in providing analysis and interpretation of the culture-environment relationship. Alan Schwartz of St Lawrence University presented a case study of the planning and execution of the 1980 Winter Olympics at Lake Placid, an elaborate development undertaking in the midst of northern New York 's Adirondack Park. This project, relevant to the workshop because of the proximity of the 1988 Olympics to Banff Park. illustrated ways in which environmental and economic interests can be served through a systematic management process.

Valerius Geist of the University of Calgary, John Baldwin of the University of Oregon and William Stapp, retiring NAEE President from the University of Michigan, delivered keynote addresses prior to small group sessions on ecological, cultural and educational imperatives, respectively, in sustaining development. Geist emphasized the necessity to maintain the regenerative and therefore productive capacity of soils, to preserve protected natural areas as the 'seed stock for ecological recovery of damaged lands, and to control toxic pollution of food chains, a hazard which may be reaching crisis proportions in some of the most highly industrialized parts of the world.

Baldwin stressed lifestyle implications of the emerging post-industrial society in the west. Citing such works as Naisbitt's Megatrends and Toffler's The Third Wave, he suggested that the arrival of the Information Age raises possibilities of reduced energy consumption, resource utilization, and pollution output per unit of production as the 'smokestack' industries are replaced with computers and robotics. At the same time, decentralizing tendencies accompanying this "information revolution" may create new environmental problems as populations move away from urban areas to settle in and around high quality often protected natural areas.

Stapp outlined a comprehensive and systematic strategy for environmental education, truly a systems approach which would enable the educational process to mirror interdependent, interacting characteristics of the human ecosystem. His analysis related the formal and nonformal dimensions of education, the public and private sectors of society, the producer and consumer elements of economy, the decision makers and general citizenry of the state, the rural and urban portions of the landscape, and the natural and built environments. Stapp emphasized the roles of holistic thinking, effective communication and individual impowerment as necessary techniques to provide environmental education with the organization and momentum to grow in influence.

For the more than one-hundred participants the highlight of the workshop was the brainstorming process on the imperatives in nine small groups, each mirroring the international, gender and professional characteristics of the workshop as a whole. General reporting sessions captured some of the richness of the small group sessions but were unable to communicate effectively the subtle elements of discourse and the intense fellowship which occurred. Although few new insights about ecological and cultural imperatives emerged, the focus and content of conclusions and recommendations regarding environmental education were gratifying especially in the integration of ecology and culture in the educational strategy.

Beyond structural shortcomings, several significant weaknesses seem to emerge in evaluating the Lake Louise and New Delhi workshops. Although each workshop was intended to focus on its own regional setting, i.e., highly industrialised North America and developing parts of the World respectively, little in the discussions produced new conceptual linkages for tangible articulation of interdependency and cultural bonding between the so-called developed and developing regions of the biosphere. Lacking the specifics of a sophisticated consciousness of the biosphere strategies for environmental education evolved in single region.

Especially at Lake Louise, the inability to analyze ecological and cultural imperatives concretely heightened the culture bound character of the educational imperatives identified. Clearly, the educational strategy evolved at Lake Louise is based upon a western democratic world view and its application is largely limited to these societies. A more scholarly treatment of ecological and cultural imperatives would both strengthen the basis for cross-cultural environmental education and increase the science and humanities content of environmental education.

Two illustrations demonstrate the pitfalls of education lacking such content. On the ecological front, the knowledge of educators seems to have advanced little beyond the holistic ecosystems thinking propounded during the 1960s. Since that time notions such as "diversity begets stability" and generalized concepts of interdependency, natural cycles, threshold effects and equilibrium have become environmental education dogma. Too many educators seem simply to propagandize this ecosystem ideology not engaging themselves in the kind of scholarly inquiry which continually tests the veracity and applicability of generalized principles. It would seem that educators have an obligation to remain current in the knowledge base aswell as the process of education.

If 1960s ecological tenets seem too abstract for solid scientific analysis, the ground may be even less secure in utilizing long standing environmentalist views about the character of industrial society to describe current cultural realities. Although humanists and social scientists are only beginning to interpret the impacts of the Information Revolution, it seems clear that computers, robotics and bioengineering are having dramatic effects upon energy requirements, resource utilization and waste generation. Not only is the nature of global economy being changed radically as older 'smokestack industrial enterprises are considered obsolete by information age technologies but silicon chip production requires dramatically less energy and fewer resources, and generates less waste- the degree to which waste being generated is hazardous still being open to question. One example of the changing reality for the developing world is the folly of perceiving the construction of steel plants as a panacea for economic development.

Both workshops and the movement for sustainable developmen received considerable publicity due to their international character and their relationship to events which attracted promine media attention. The New Delhi gathering culminated in the observance of the World Environment Day, June 5, featuring program including addresses from the Honourable Zail Singh, President o India, Mustafa Tolba, Diector of the UNEP, and Craig Davis, Secretary General of the World Council for the Biosphere. NAEE attracted Noel Brown, New York Director of the UNEP, Al Baez, Chairman of the Commission on Education of the IUCN and John Fraser of the Canada House of Commons and former Minister for Environment.

On balance, in spite of the clear potential for improvement, the Lake Louise gathering, like that of New Delhi before it, contributed significantly to the forging of an effective international network of environmental educators working more intelligently than before for the ecological sustainability of the biosphere. Unquestionably, both workshops furthered significantly the goal of the International Society for Environmental Education to link educators and educational organisations on a scale encompassing the Earth's biosphere. The challenge for the future is to extend this networking and assessment process to other continents building upon our experiences to date.

Appendix A. THE BANFF DECLARATION

In October 1984, The North American Association for Environmental Education convened an international meeting on environmental education in Banff, Alberta, Canada, attended by representatives from 28 nations, including several from the developing world. The conference was international not only in its participants but also in the global nature of its concerns.

Twelve years after the United Nations Conference on Human Environment held in Stockholm in 1972, it is evident that the overall quality of life for vast numbers of people is now worse than it was, and that the state of the global environment continues to deteriorate.

Therefore, we as environmental educators, affirm that the current educational approaches and the back-to-basics movement in education will fail to meet the needs of humanity unles we begin at once to address the serious environmental concerns that presently face every member of the world community. The new basic education must endow learners with environmental competencies that will enable them to contribute to the resolution of local and global problems and to the development of an ecologically sustainable society. Such competencies will need to be supported by a new environmental ethic that embraces the whole of the natural order with which human societies must live in harmony for survival. This movement must achieve no less than an infusion of the new environmental ethic into every aspect of the educational process.

In light of this, we, the participants of the Banff Conference, call for an unprecedented effort of educators throughout the world to restructure their entire educational programs, to meet effectively the urgent needs of humanity and of the planet.

Approved October 8, 1984, by participnts at the annual conference of the North American Association for Environmental Education, Lake Louise, Canada.

Appendix B

Proposed Recomendations of the NAEE Sections Workshop on Environmental Education Imperatives
(Lake Louise, Banff, October 9, 1984)

1. In the spirita of the Banff Declaration, we recommend that a "Global Environmental Education Strategy" be devised which will improve the resolution of local and global environmental problems.
2. We recommend that environmental educators support their own value systems by beginning to regard themselves as being at the center. rather than on the periphery, of educational concerns, policy, progrmmes and institutions.
3. Because environmental education is holistic, unavoidably cross disciplinary, dynamic, and closely connected to nature and the out-of-doors, we recommend that strategies to overcome institutional and fiscal restraints on field studies, classrooms without walls, site visits, team teaching and new educational approaches be pursued with renewed confidence, enthusiasm and vigor.
4. (a) We recommend that environmental educators consider the development of curricula and programmes which start at the personal and local level, and which also extend to international and trans-cultural horizons. (b) We further recommend that consideration be given to the development of a world Environmental Education Fund to support and make real the possibility of the new "environmental ethic" called for in the Lake Louise Declaration.
5. In light of the importance of information to development of sound environmental behaviour and decisions, in the developing as well as the developed world, (a) we recommend that environmental educators place renewed emphasis on free access to and dissemination of data on environmental matters, utilizing the most advanced and effective tools and techniques which modern technology has to offer, making special efforts to transfer this information technology to the developing world, and (b) we recommend that environmental educators place inreased emphasis on communications skills development: writing, speaking, organizing and networking, and more effective use of communications channels.
6. We recommend that programmes and facilities which enable the continuois and life long pursuit of environmental knowledge be developed in many sectors of society: home and family, church, community and nation, business and government. This calls for extension of environmental education techniques beyond conventional boundaries.

To implement these recommendations it is PROPOSED: That the NAEE Sections Workshop, in the spirit of the Banff Declaration forward the above recommendations along with the workshop reports and keynote papers to the NAEE Board of Directors as our contributions to the development of the first "Global Environmental Education Strategy."

ENVIRONMENTAL MANAGEMENT

Rahimuddin Ahmad*

Man's desire for ultimate joy and comfort has led him to exploit nature's free goods to the extent of reducing its natural capacities for self-stabilization. As a consequence of this outright disregard of the impact of these activities on the environment, numerous environmental problems have arisen.

In southeast and east Asia the major problems are increasing population density, rapid urbanisation and industrial growth, inadequate food, and depletion of resources. Pollution is a new area. To meet the increasing demand of time, people deliberately modify the natural environment in order to improve their quality of life. Unknowingly however, different development activities such as construction of roads, dams, airports, irrigation and severage systems, power plants and industrial facilities have some repercussions on the environment in which man lives. Man shapes the earth which in turn shapes him.

When studying the impacts of these activities, it is tempting to recommend a moratorium on change. But certainly, this is out of question for one would not want to pay a fraction of the price of technological stagnation. Technological change is a national necessity in a developing world and thus must not be frozen. What is needed is the concept of environmental planning and management coupled with an understanding of the ecological concepts, methods and skills. And since the problem is not only local but global in its dimensions and consequences, the solution can only be achieved through international cooperation and understanding among nations with the rich countries helping the poor ones.

There should be no delay in tackling the task of solving the environmental problems because they have a cumulative impact. If remedial action is taken only at a later stage, its cost will considerably higher and the damage irrevocable (World Bank 1975). There is only one world to pollute: if this one is ruined, there is no other. Man survives only as long as the earth survives in her present form.

The Ecosystem and the Environment

Ecosystem and Environment' are words which are often loosely defined. An ecosystem is a relatively self-contained system of organisms and their environment. The study of the ecosystem's structure and fuctioning, and its changes is known as

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Vice Chancellor, Magadh University, Bodh Gaya, India ecology. Ecologists explore the interactions between man and his environment.

Environment, on the other hand, may be defined as protection. "The sum of all social, biological and physical or chemical factors which compose the surroundings of Man...". This places emphasis on the broad scope of the environment in terms of practically everything that surrounds man. This definition is further elucidated by the "Stockholm Declaration" that "Man is both creator and moulder of his environment which gives him physical sustenance and affords him the opportunity for intellectual, moral, social and spiritual growth... Both aspects of man s environment, the natural and the man made, are essential to his well-being and to the enjoyment of bsic human rights, even the right to life itslf" (Chamlett 1973).

Thus man is firmly located as part of the global ecosystem, which depends on him as much as he depends on it even though the view point of the environmental management process is fundamentally that of Man (i.e., the manager) whose decisions determine whether he himself or even the rest of the global ecosystem will survive at all Royston and Perkosevki 1975).

Classically, the total environment is divided into the atmosphere, hydrosphere, lithosphere (geosphere) and the biosphere. These divisions are some what arbitrary, because they are completely interrelated. Their basic characteristics are as follows:

Atmosphere: The gaseous envelope surrounding the earth composed of the entire mass of air containing primarily nitrogen, oxygen, water vapours, carbon dioxide and inert gases.
Hydrosphere: The aqueous envelope of the earth, including the oceans, all lakes, streams, and subsurface waters, the water vapour in the atmosphere, and water in the form of ice.
Lithosphere: The solid rocky portion of the earth made up of the crust of normal silicate rocks and the metal compound of silicate material, the lithosphere surrounds the solid-liquid core (Siderosphere) of iron and nickel alloy.
Biosphere: The biologic envelope that surrounds the globe containing and able to support life without the help of artificial systems. It penetrates into, and is dependent on the atmosphere, hydrosphere and the lithosphere.

The normal environment of man on the other hand consists of the air, water, solid waste, noise, radiation, soil, wildlife, timber, living space, etc. while his man-made environment consists of the work environment, housing, technology, asthetics, transportation, utilities and settlement, etc.

These environmental components can be considered as a resource to be exploited to fulfil the basic physical needs of the people, they can be considered as facts of global knowledge base which contribute to man s intellectual well-being or they can be considered as a part of the enigma which concerns man and his role in the world, and his striving for a solution which will provide the basis for a sense of purpose in life (Edmund & Letey 1973).

Each component can then be examined to see to what extent it is affected by each activity of a given project. A thorough knowledge of these environmental components is essential in establishino environmental priorities.

DEVELOPMENT AND ENVIRONMENT

Tragedy of Commons

The atmosphere and the oceans which encompass most of the globe are properties of common usage. They are what we call the commons. They consist of all those attributes of the earth which humans and other species jointly use, which is to say that there is no exclusive ownership right but rather some form of common usage rights. The ocean encompass shipping, commerce, fishing, recreation, missiles ranges and research as well as fishes, birds, sea plants and the hydrologic cycle of evaporation and rainfall. The atmosphere as a common is used by human beings and other forms of living beings for breathing, and by combustion engine as a power source. However, this concept of common usage is the ideal only when population density is low, because when the demands are more than the supply, what results is the overuse of the commons which remorselessly generate tragedy.

This tragedy of commons develops in this way. Picture a pasture open to all. Each herdsman will try to keep as many cattle as possible on the commons. As a rational being, he seeks to maximise his gain, so he thinks of the result to him when he adds one more cow to his herd. He later realises that this result has one positive and one negative components. The positive component is that with the addition of one cow, he increases his profits from the sale of its milk and thus the positive component is nearly +1. The negative component is a function of the additional overgrazing created by one animal. Since however, the effects of overgrazing are shared by all the other men, the negative component for any one herdsman is only a fraction of -1. So adding together the components, he realizes that the most sensible thing to do is to add another cow to his herd. And another, and another... until overgrazing results in erosion, since the same decision is also taken by the other herdman. The final result is the tragedy of commons.

Every man increases his herd without limit in a world which is limited. Only a few benefit from the short term gain, while the rest of society suffers. The users of the sea meanwhile, believing that the resources are inexhaustible continue to bring species of fish and whales close to extinction (Carwell and

Tadlock 1971).

In a reverse way, the tragedy of the commons reappears in problems of pollution. Here it is not a question of taking something out of commons but of putting something in sewage, chemicals, radioactive and heat wastes into water; noxious and dangerous fumes into the air, and distracting and unpleasant objects into the line of sight. Since rational man finds it cheaper to discharge his wastes than to purify them before discharge he and all others continue to do so, eventually "fouling their own nest".

In short the concept of commons if justifiable at all, is only justifiable under conditions of low population density. The control of human population has had to be abondoned in one aspect after another. However, abandoning the concept of the commons involves the curtailment of somebody's personal liberty. Cries of rights and freedom will soon fill the air if this ensues. What if instead of abandoning the total concept of the commons the necessity of abandoning the freedom to breed is recognised?

The only way to stop the upcoming cries of rights and freedom is to nurture and preserve other and more precious freedoms of the commons by relinquishing the freedom to breed, and that very soon. As Hegel would put it "freedom is the recognition of necessity and it is the role of education to reveal the necessity of denying the freedom to breed to the present and the next generation to follow. Only then, can the tragedy of the commons be put to an end.

The Limits to Growth

"If the present growth trend in world population, pollution, food production, and resources depeletion continue unchanged, the limits to growth on this planet will be reached sometimes within the next one hundred years". This is the thesis of the limits to growth, a controversial study by MIT team led by Dennis Meadows (Meadows et al. 1972).

Using a model developed by computer experts, the Meadows team translated five growth trends and their interlocking relationships into mathematical terms. They found that even under the most optimistic circumstances including unanticipated technological breakthroughs by man of major significance, the limits to growth would be reached by the year 2100 if present trend continues.

Further more the report says that the most probable result will be a matter sudden and uncontrollable decline in both population and industrial capacity. The five major predicaments of mankind follow the same pattern. Population cannot grow without food (they argue), food production is increased by growth of capital (more tractors, fertilizers, pesticides), more capital requires more resources, discarded resources cause pollution,

pollution interferes with the growth of both population and food.

The key to the findings about the limits to growth is the assumption that the major growth trends, population, industrialisation, food production, depletion of resources and environmental degration, increase in geometric progression. Growth thus is slow at the beginning but in a short time reaches a staggering level.

Collapse can only be avoided according to the authors, if man is prepared to limit growth and settle for a condition of economic and eclogical stability. Population should be stabilized by analysing birth and death rates. Industrial growth must stop except to replace the old facilities. Behavioural patterns must change, man must learn to prefer services, such as education and recreation to material goods.

Many critics assert that "the limits to growth" oversimplify reality, that little allowance is made for reality, that little allowance is made, for example, for human factors. If there is cause for deep concern, there must also be cause for hope. Man will prevail for he possesses the powerful combination of knowledge , skills, tools and resources to promote economic growth and to create an environment which is a joy to live.

Concept of Quality of Life

The objective of development is to improve the qualiy of life. In the beginning the quality of life (QOL) was visualized in terms of standard of living (SOL) where

$$\text{SOL} = \frac{\Sigma\,\text{Production}}{\text{Population}}$$

Now the industrialized nations have witnessed the deterioration of the environment and the model for the quality of life (QOL) has changed as follows:

$$\text{QOL} = \frac{\Sigma\text{Production} - \Sigma\,\text{Losses}}{\text{Population}} + \frac{\text{Services/Time}}{\text{Production}} + \frac{\text{Experience/Time}}{\text{Population}}$$

The model includes losses because goods have a limited useful life, and as material comforts, it is likely that the good life is defined be services, and as services become more abundant the emphasis may increase but experiences are likely to decrease because of the growing deterioration of the environment.

So as not to overuse the limited environmental resources which would otherwise reduce the quality of the life of man, an optimum balance between economic development and environmental control should be maintained in developmental planning within a country, for man to live a quality life. For what use is it, if in promoting economic growth, man creates an environment which is not a joy to live.

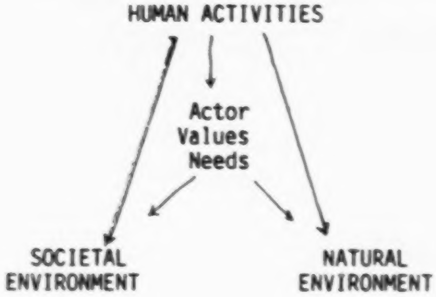
Impact of Development on the Environment

The urge for economic progress is comon to all developing nations. Massive developmental activities are being undertaken to meet and satisfy the demands for higher standards of living of an ever-increasing population. The lack of capital goods and the foreign exchange to purchase them abroad are the major bottlenecks in development efforts. Because of an outright disregard of the impact of these activities on the environment, the results will surely be the exhuastion of the natural resource products as agricultural and aquatic commodities, oil minerals and timber and in the long run, environmental problems which reduce the quality of life.

The development of natural resources for economic benefit is desirable, unless accompanied at rates, and by means detrimental in the long run. Whether resource development programmes prove to be beneficial or destructive depends largely on how far scientific knowledge is applied in their formulation and on the ability of government agencies to control their implementation (Conway and Romm 1973). In south east Asia the impulse for rapid economic development is far stronger than the social incentives for scintific investigation or for the advancement of capabilities in government management of resources.

Managing the Environement

Man draws upon components of his natural and societal environment to sustain his various activities which are aimed at satisfying his needs and these activities in turn have impact or repercussions on the components of his environent (Lohani and Thauh 1977). Environmental management must regulate the demands of man in such a manner that the ability of the same environment to sustain his development will remain unimpaired. This is easily seen in the figure given below:



Key Concepts of Environmental Management

For environmental management to be effective and systematic, it must consistently, within the existing limitations of knowledge (Garlauskas 1975), visualise all processes (natural and artifical) in total perspecticve, recognise and understand any process or problem in the structure and its components interrelationships, be able to manipulate or otherwise deal with the interdependences characterising the process or operation as a whole; be able to design, build and operate the management system which would serve as a means to manage any whole.

The activities of man affecting the equillibrium between him and the environment can be arbitrarily classed as unbalancing and compensating factors. In examining the stress anti-stress patterns, it can be seen that advances in higher level technology with improved medicine have reduced the death rate and lengthened human life span. The increased population and the resulting demands have imposed a variety of stresses on the dynamic equilibrium between man and the environment.

Environmental management and science employ the following three concepts.

Systems Approach: A procedure which recognizes the relationship between natural and man-made systems, between systems and analysis and management techniques and the critical role od the human factor.

System Analysis: A technique of problem formulation, issue definition, and part insight. Systems analysis concerns itself to finding solutions to a problem and does not concern itself with appplying those solutions. It consists of techniques that can be used to find solutions.

Systems Management: Consists of actual techniques of management for solving problems such as CPM/PERT, PPBS, CSPCS/SE and others. These techniques prescribe a measurable path to achieve stated environmental correctives with milestones along with the way to chart progress.

Essentials of an Environmental Policy

In formulating environmental policy, the important considerations listed below must be taken into account.

1. It must extend over a long term and be capable of dealing with many contingencies.
2. It must be flexible to allow for the excercise of political judgement and refinement with time.
3. It must outline a strategy for implementation through time.
4. It must focus on the changing patterns of behaviour and include implementation plans.
   --structuring of decision-making

  - --definition of national properties
  - --administrative structure
  - --rationalizing legislations
5. It must be able to accommodate simultaneously the past, present and future.
6. It must be designed to minimize misuse or use for other purposes
7. It should aim at enforcement.
8. It should be a synthesis of activities - not just concentrate on pollution studies.
9. It must face the problem of public participation - education, inputs, complaints.
10. It must include a strategy for collecting information and application and dissemination.
11. It should define responsibilities particularly with respect to the most important issues.
12. It must strike a balance between generalities and specialities.

An environmental act should embrace all the vital components interacting in the energy-resource and environment system.

CONCLUSIONS

The problem is that many developing countries feel that concern for environmental issues is a luxury and an added financial burden to them in their efforts to achieve economic and social progress. Being more concerned with development, these countries assume that environmental deteriortion must be risked for economic growth.

To improve the quality of life (QOL) however, environmental quality and development must go together. Environemental management must undertake the task of regulating man's activities in such a manner that the ability of the same environemnt to sustain his needs is unimpaired. Any developmental endeavour must be accompanied by environmental impact assessment methods and environmental management concepts, strategies and skills, for a balanced and dynamic equilibrium collaborative efforts and understanding among nations is a must for finding a feasible and rationsl solution to the problem of maintaining an dynamic equilibrium for a quality life.

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A COASTAL ZONE MANAGEMENT PROGRAMME FOR KERALA STATE

M. Baba*

INTRODUCTION

The coast is an interaction zone of land and sea. The sea coasts, because of their rich fauna and flora and their access to the water transport, have attracted the settlement of populations from time immemorial. The rich fisheries and easy navigational facilities lead to various industrial, commercial, civil and other developmental activities. This in turn have resulted in the further population growth. So, these developments have definitely brought considerable growth in the coastal economy. But, many of the developmental programmes which are traditionally independent and irrational, may produce innumerable conflicts and problems in its wake.

The picture of the coastal zone of Kerala, which is about 560 km long, is not different. The fortyone west flowing rivers, which at the coast transform to lakes and estuaries before joining the sea, bring enormous quantities of nutrients and soils making the waters and land highly fertile supporting rich fisheries and high agricultural productivity. The irrational development of this coastal zone without taking into account the limitations of its natural environment, has led to intensive coastal erosion, pollution of its water bodies, land and air, silting of waterways and ports etc. (Baba 1985a). This paper looks into the capabilities of this coast, its limitations and problems and suggests a coastal zone management programme, with all its components, as a potential tool inolving the problems and in maintaining the quality of the coastal environment and its balanced development.

THE COASTAL ENVIRONMENT AND ITS RESOURCES

Geographical Setting

Kerala, the tiny state in the southwest of India, is bounded by the western ghats in the east and the Lakshadeep sea in the west, has a total length of 560 km. The state is divided into highland, midland and lowland, in which the latter has a height of less than 8 m above MSL (Fig. 1). For convenience this portion which is about 10-15% of the total area, is referred to as the coastal zone (until a suitable definition is discussed in the last chapter). Forty one west flowing rivers reach the sea through this coastal zone. The major ten rivers carry nearly 45,060 mill. cu.m water per year. Many of these rivers are dammed for the purpose of power generation or irrigation. Most of these rivers before joining the sea drain into the backwater systems like Vembanadu, Ashtamudi, etc. The backwater and river systems in the coastal zone are interconnected and supports 810km coastal waterway. These water bodies have considerable socio-economic influence on the Kerala s coastal zone. Kerala is most densely populated (25.455 million, based on 1981 census) in India with the coastal zone sharing about one-third of it. Average density in the coastal zone is 1500 persons per sq.km (Fig. 2). Near the urban centres it is more than 2000, with some selected areas near Cochin, Trivandrum, Calicut, Tellicherry etc. accommodating even much higher concentration. The growth rate is also much higher in the coastal belt.

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Resources of the Coastal Zone

The major renewable resources available along this coastal zones are water, agriculture and fishery, and the non-renewable resources include mionerals, soils, sand etc. The details are given in Baba (1985 a). The water resources are surface and groundwater, in which the latter has considerable potential for development, as a major drinking water source. The agricultural products include coconuts, rice, tapioca, cashew etc. The marine fisheries production here is estimated at 23% of country s total production. The fishing area is about 25000 sq.km and the fishermen population represents 3.13% of State s population. In addition, nearly an equal number is involved in the mechanised fishing sector and its related industries. The inland fishing is also prevalent in the coastal zone.

The mineral resources potential of this coastal zone is weak, except for the placer deposits, which occupies the pride of place in India. A recent estimate shows (SCST 1982) that this coast has 23 million tonnes of ilmenite and 1.3 million tonnes of rutile, mainly concentrated in the Neendakara and Kayamkulam belt. Clays, glass sands and limeshell deposits are also reported along this coast.

Developments in the Coastal Zone

Due to the high population density and favourable environment, this coastal zone has undergone substantial development. Out of the fourteen, seven district headquarters, all the three municipal corporations of Trivandrum, Cochin and Calicut and five municipal towns (excluding district headquarters) are situated within the narrow stretch of the coast (Fig. 2). At least half of the total industrial concerns of Kerala are situated along this coast, with a maximum concentration at Cochin. These include rare earths, chemical, fishery, coir and boat building industries.

Major part of the coastal areas are connected by roads, railway and water transport systems. Both the airports of Kerala at Trivandrum and Cochin are situated in the coastal zone. The major port at Cochin, which is the second largest in the west coast of India, has played an important role in the economic development of the State as a whole, this part of the coast in particular. There are 14 more intermediate or minor ports along the Kerala coast.

Out of the 560 km coastal belt, 370 km of the coast is found to undergo erosion (Fig. 3). To combat this, a series of structures, mainly sea walls and groins have been constructed along more than half of the eroding portion. Two major schemes like the Thanneermukkam bund and the Thottappally spillway have been constructed to control flooding and salt-water intrusion into the rice-granary of Kerala, the Kuttanad belt. The high density of population in this zone has necessitated a large scale housing development in the coastal zone. Near the urban centres the density of housing has reached such alarming proportions that the fisherman even encroach the newly accreted beaches, which are quite unstable; Due to the presence of a large number of urban and industrial centres, this coastal zone in addition to all the above, has established considerable amount of commercial, recreational, educatinal and other facilities, adding to the pressure already existing in this area.

ENVIRONMENTAL PROBLEMS

The natural coastal environment, coupled with its development programmes have, no doubt, boosted that economy of the State as a whole . However, certain development programmes and the nonconsideration of certain environmental limitations of this narrow strip in the planning process have invited considerable amount of problems and conflicts in its wake.

Coastal Erosion

The erosion has become critical for Kerala State, which is already facing the shortage of land due to its high density of population. Various coastal protective measures, mainly seawalls have been adopted from time to time to protect this coastal land ..om the attack of the sea. Now, it is believed that these are the only remedial measures for coastal erosion. But, it is observed that these structures help the coast only in a few places: in others they get damaged or damage the neighbouring coasts due to

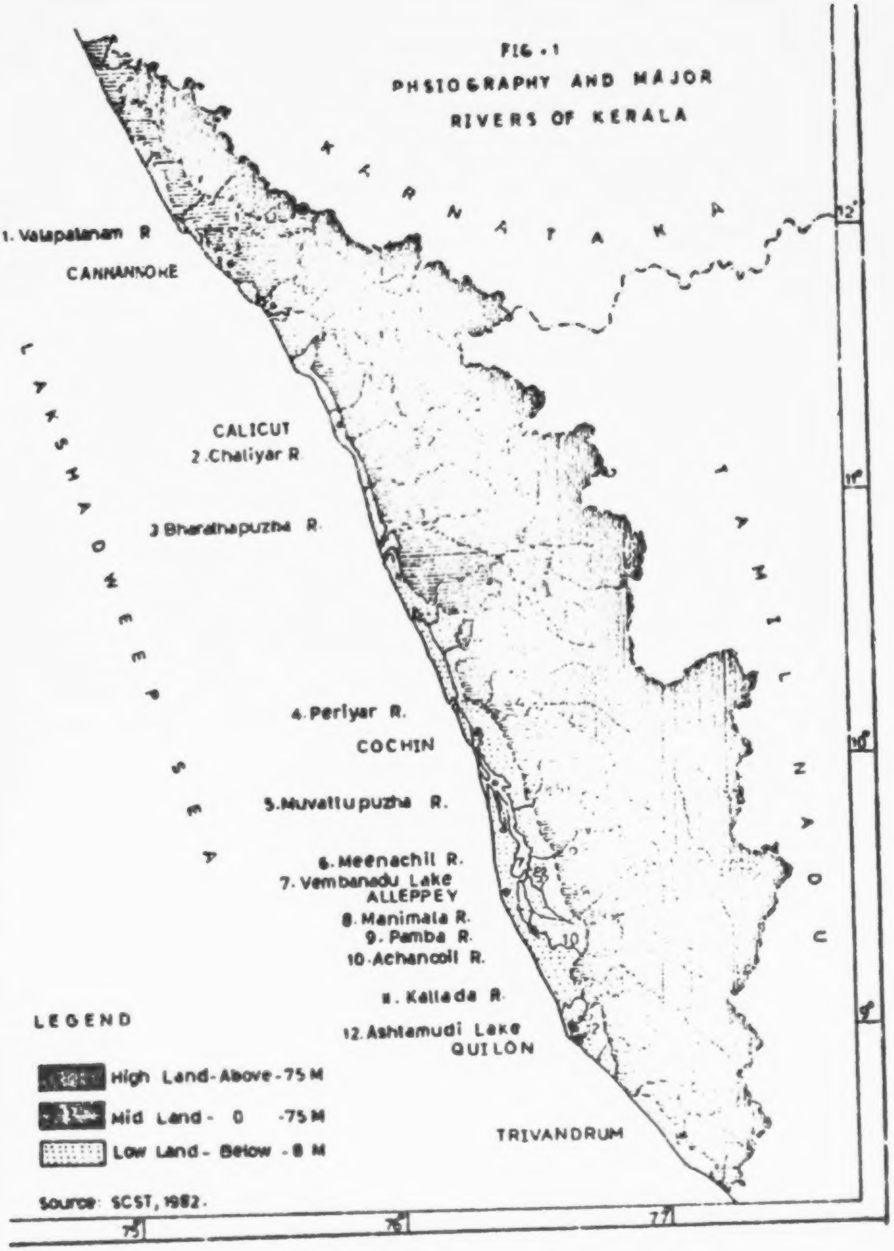

FIG. 1
PHSIOGRAPHY AND MAJOR RIVERS OF KERALA

K A R N A T A K A
T A M I L N A D U
L A K S H A D W E E P S E A
1. Valapatanam R
CANNANNORE
CALICUT
2. Chaliyar R
3 Bharathapuzha R
4. Periyar R.
COCHIN
5. Muvattupuzha R.
6. Meenachil R.
7. Vembanadu Lake
ALLEPPEY
8. Manimala R.
9. Pamba R.
10. Achancoil R.
11. Kallada R.
12. Ashtamudi Lake
QUILON
TRIVANDRUM
12°
11°
10°
9°
75
76
77

LEGEND

▨ High Land - Above - 75 M

▨ Mid Land - 0 - 75 M

░ Low Land - Below - 8 M

Source: SCST, 1982.

down coast/end erosion. The down coast erosion is also seen at the shipping channel, harbour structures, mudbanks, etc. which obstruct the littoral drift along the coast. The other methods suggested like vegetative fencing. beach nourishment and breakwaters are neither fully studied nor attempts made to implement them (Watts 1965, Moni 1972, Baba 1979a, 1981b). The danger will continue and may increase with increase in population and human acivities viz., urbanization, construction of dams, prevention of soil erosion on the midland and highland of the State, development of harbours etc. (Baba 1979b) unless early suitable solutions are sought.

Encroachment of Beaches and Coastal Lands

The Kerala s beaches are very fragile and they are the result of cyclic sedimentary processes. One beach, which is maintained for a particular period, may not necessarily remain there for ever. The occupation of these lands are hazardous. In spite of the few warnings by certain Governmental agencies, and the regulation of the Govt. of India to keep 500 m as buffer zone, the laws of the State do not fully prohibit such occupations. (The State issues title deeds to the encroachers). This leads to great to the life and property during the rough seasons and it becomes the liability of the Governmnet to rehabilitate this population and even to feed them for a long period. Some regulations based on systematic planning are required for housing development in the coastal zone.

Coastal Flooding and Salt Water Intrusion

Flooding due to heavy rainfall is a common feature in the coastal zone of Kerala State. In addition, to the natural reasons as mentioned above, the urbanization and construction of artificial structures, reclamation of wet lands and others also contribute to this. Every year the salt water intrusion into the agricultural lands due to flooding create problems to the coastal agricultural population along the Kerala coast. It needs mention that some measures such as construction of bunds like Thanneermukkam, Thottappally spillway etc. are undertaken to solve this problem, but they have created only further technical, social, economic and environmental problems which require a comprehensive study.

Coastal Pollution

Even though pollution of the coastal waters and lands has not reached the measure by which it is observed in the advanced countries, rapid industrialization and urbanization of certain areas has brought this monster to this region. The water of the

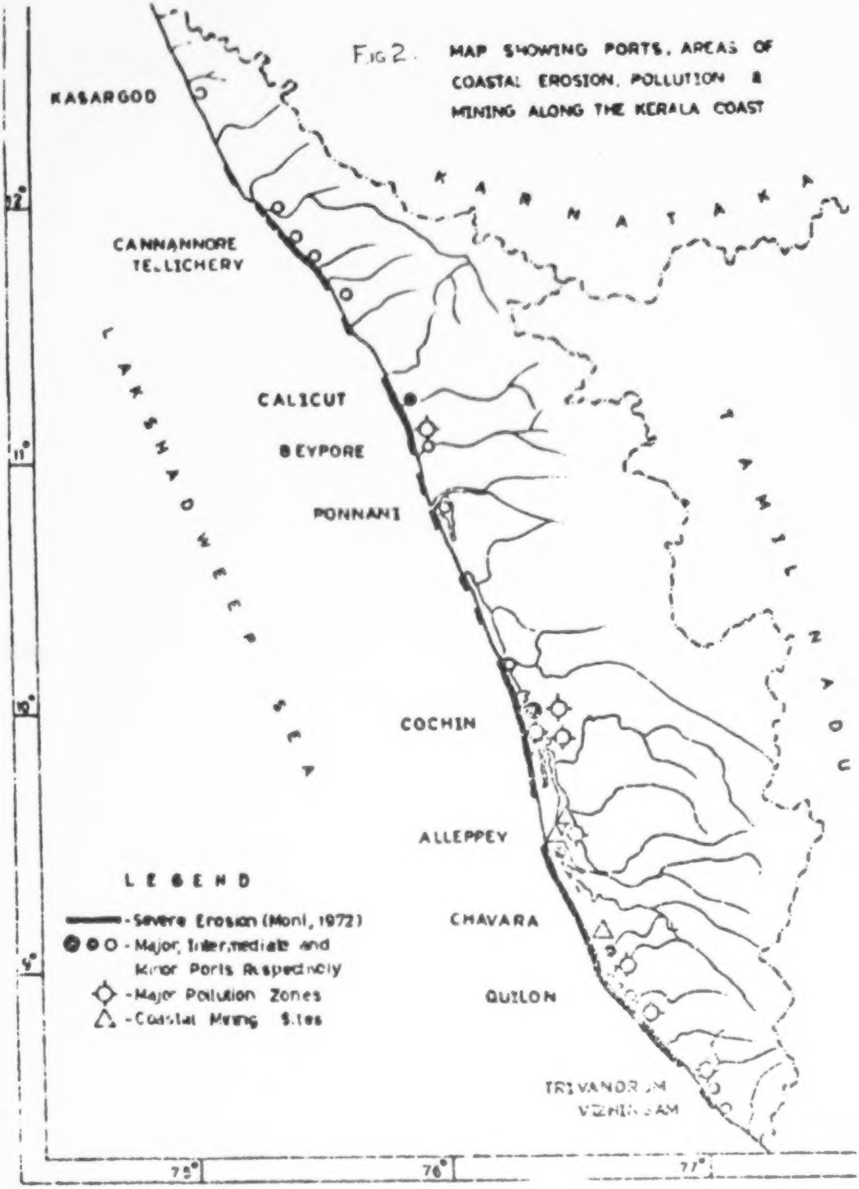

FIG 2. MAP SHOWING PORTS, AREAS OF COASTAL EROSION, POLLUTION & MINING ALONG THE KERALA COAST

KASARGOD
CANNANNORE
TELLICHERY
CALICUT
BEYPORE
PONNANI
COCHIN
ALLEPPEY
CHAVARA
QUILON
TRIVANDRUM
VIZHINJAM
KARNATAKA
TAMIL NADU
LAKSHADWEEP SEA
12°
11°
10°
9°
75°
76°
77°
LEGEND
- Severe Erosion (Moni, 1972)
● ◎ ○ - Major, Intermediate and Minor Ports Respectively
- Major Pollution Zones
△ - Coastal Mining Sites

five rivers, namely, Chaliyar, Chalakudi, Periyar, Pamba and Kallada and the majaor backwaters like Vembanadu and Ashtamudiare subjected to pollution (Fig. 3), due to the indiscriminate discharge of effluents from the industries, untreated sewage from the municipalities and wastes and chemicals from agricultural operations. It is generally believed that the estuaries and seas can be freely used for the discharge of effluents on the pretext that this saline waters are useless for consumption, irrigation etc. However, their impact on the marine living resources have been presently understood.

The pesticides, insecticides, water hyacinth, salvinia etc. also cause considerable problems in the coastal waters. Among these, the salvinia and water hyacinth requires special mention, as their instantaneous multiplication capability has caused its spreading in all the water bodies and even agricultural lands blocking water transportations and agricultural practices along the Kerala s coastal zone. A suitable measure to contain this menace is yet to be evolved. Another problem worth mentioning is the land pollution due to waste and sewage disposal, especially in the urbanized localities. This along with the pollution of the water bodies have reduced the quality of the groundwater, which is the major source of drinking water in the coastal zones.

Conversion of Wetlands

In Kerala, after independence, due to the scarcity of usable land and due to urbanization, the conversion of wetlands of the coastal zone for housing, transport, industries and agriculture has become a regular phenomena. The backwaters are coverted as paddy fields. Paddy fields are converted as coconut plantations. Once the land achieves some stability it attracts civil and commercial activities. This may be feasible in some areas, but hazardous in most of the regions due to the saltwater intrusion, seasonal flooding, ecological impacts, etc. trigerred by it. Although it may be necessary to reclaim land from socio-economic considerations proper investigations should be carried out prior to the implementation of such schemes, so that the land development does not lead to outer environmental problems.

Over-Population

To concentrate all the industries and urban development in the coastal zone is a world-wide process. This may be due to the easiest and most convenient transportation facilities available there and also due to the difficulty in finding out a place more convenient for waste disposal than the sea coast. The urbanization has attracted the population from the interior. If the present trend continues without proper control and planning a coastal zone development programme will become more dear in the nearest future. Immediate programmes are required to control this exodus from villages to urban centres and also for improving the health, employment, housing, cultural and economic conditions of the coastal population.

Commercial Fishing Problems

Fishing industry during the past fifteen years witnessed rapid strides in Kerala, first due to the intensive research and secondly due to the partial mechanisation of the industry. But major part of the industry still runs with traditional crafts and gear. Docking facilities are poor and the seawalls, which are spread throughout the coast, obstructed the shore based fishing. There exists disputes between the traditional and mechanized sector. In the recent years, there had been some decrease in the total production, which is supposed to be due to overfishing.

In addtion to all the above, there are many more socio-economic problems requiring immediate atention.

POTENTIALITIES OF KERALA COAST

In spite of various problems faced by the coastal zone there is considerable potential for develeopment in a large number of areas. Among the resources already exploited, there are a few which can accommodate further development. These include the balanced development of the traditional and mechanised fishing industry (also aquaculture), fishing harbours and other fish landing centres, fuller exploitation of the groundwater potential for drinking purposes etc. In addition to these, the developments in the following fields are going to be vital not just for the coastal zone, but for the entire country with our march towards the twenty-first century.

Inland and Coastal Water Transport

A good inland water transport facility existed along this coast in the recnt past, with its 810 km of navigable length connecting Trivandrum in the south and Badagara in the north. These inland waters are navigable even during the monsoon season. Even though now this has been overtaken by roads and railways, in the very near future with the restraints in further exapansion of the latter systems, the re-establishement of the water transport system, which will be cheaper and more harmonious to the coastal environment, has substantial scope. With very calm coastal seas (Baba et al. 1985b) for more than 6 months continuously, another cheaper mode of transport namely coastal steamer or boat service, could be started along thiscoast.

Offshore Placer and Sand Deposits

With the present extraction of the placer deposits from the beaches, the related industries cannot survive for very long. Latest surveys by many agencies reveal that there is considerable scope for mining these deposits from the near inner continental shelf of Kerala, where the beaches have once existed, but now got submerged with the raising sea level.

One of the efficient methods of solving the coastal erosion problem, which is very severe in Kerala, is beach nourishment (Watts 1965, Baba 1979a) for which large quantities of sand are required. In order to build up the beaches without disturbing the delicate sand balance, their deposits in the offshore have to be located. There are indications of rich deposits, even in the form of shals which are very convenient for extraction, at many locations, a quantitative estimate of which is yet to bemade.

Future Energy Programme

Also another important area which will attract considerable development, particularly in the coastal zone, is the ocean based energy programme, which include the Ocean Thermal Energy Convention (OTEC), energy from waves and tides etc. With the present day energy crisis and limitations in the energy production from the traditional sources such as hydral, thermal, nuclear, etc. by the turn of the century, the coastal zone is going to play an unbelievable role in the energy programme from the above nonconventional sources. This may have to be looked into in any coastal zone planning scheme.

Recretional Demands

The cultural heritage and natural beauty of the Kerala's coastel zone with its backwater systems, greenery, coconut gardens, tropical climate, golden beaches etc., have all the potential to develop a profitable tourist industry. Very few attempts are made to tap this potential resource. Kovalam beach resort is perhaps the only major tourist attraction developed along the Kerala's coastal zone. Recreation may become an essential component of the life of future industiralized society who will be exposed to increased strains in the day-to-day life. If the coastal zone recreation facilities are not preserved and developed now, they may disappear in the nearest future with the present rate of growth of pressures in this area.

Development of Historical and Archaeologial Sites

Kerala with its rich cultural heritage has many other historical and archaeological monuments along its coastal zone. Some were destroyed due to coastal erosion and few others by man. The forts of Trivandrum, Anjengo, Fort Cochin, Cranganore, Cannanore, Tellicherry and Bekal, various churches, temples and mosques are a few worth mentioning. These monuments which survived the atrocities of nature need protection for the future generations to know their cultural heritage and past glory. They have tremendous tourism potential as well.

Resource Constraints

For the large population accumulated in the coastal zone, the resources are limited and it requires judicious exploitation. Also the environmental impacts due to the exploitation of these resources may be severe, but can be tackled with proper planning.

A terrain evaluation programme to help users to understand the type of location and its suitability for their particular use will reduce detrimental impacts on coastal areas. This will help the coastal community of Kerala where the terrain is very limited and dear, for better utiization of its resources in the most productive manner.

Need for a Data Bank

The pressures on the coastal zone mentioned earlier need immediate attention. But in order to arrive at solutions for various problems and to frame a management policy for the coastal zone the available data, which is scattered in many archives and institutions is not sufficient. This fact necessitates a program for the collection of data, essential for determining the management and development criteria of the coastal zone.

So the first major task should be to collect all the available data on this zone and to formulate programmes for the collection of other data which are not available readily. The data bank thus created will feed necessary information required for formulating the coastal zone management policy of the Kerala State.

RELEVANCE OF COASTAL ZONE MANAGEMENT FOR KERALA

In the above sections various problems and some developmental requirements were discussed independently. Detailed examination of these problems themselves and their possible solutions reveals the interrelationships between the various problems. To solve one, solution for many other have to be found simultaneously. A classic example is the coastal erosion.

Coastal Erosion: A Management Problem

Coastal eosion recurring every year is one of the biggest problems faced by the State. The problems associated with the

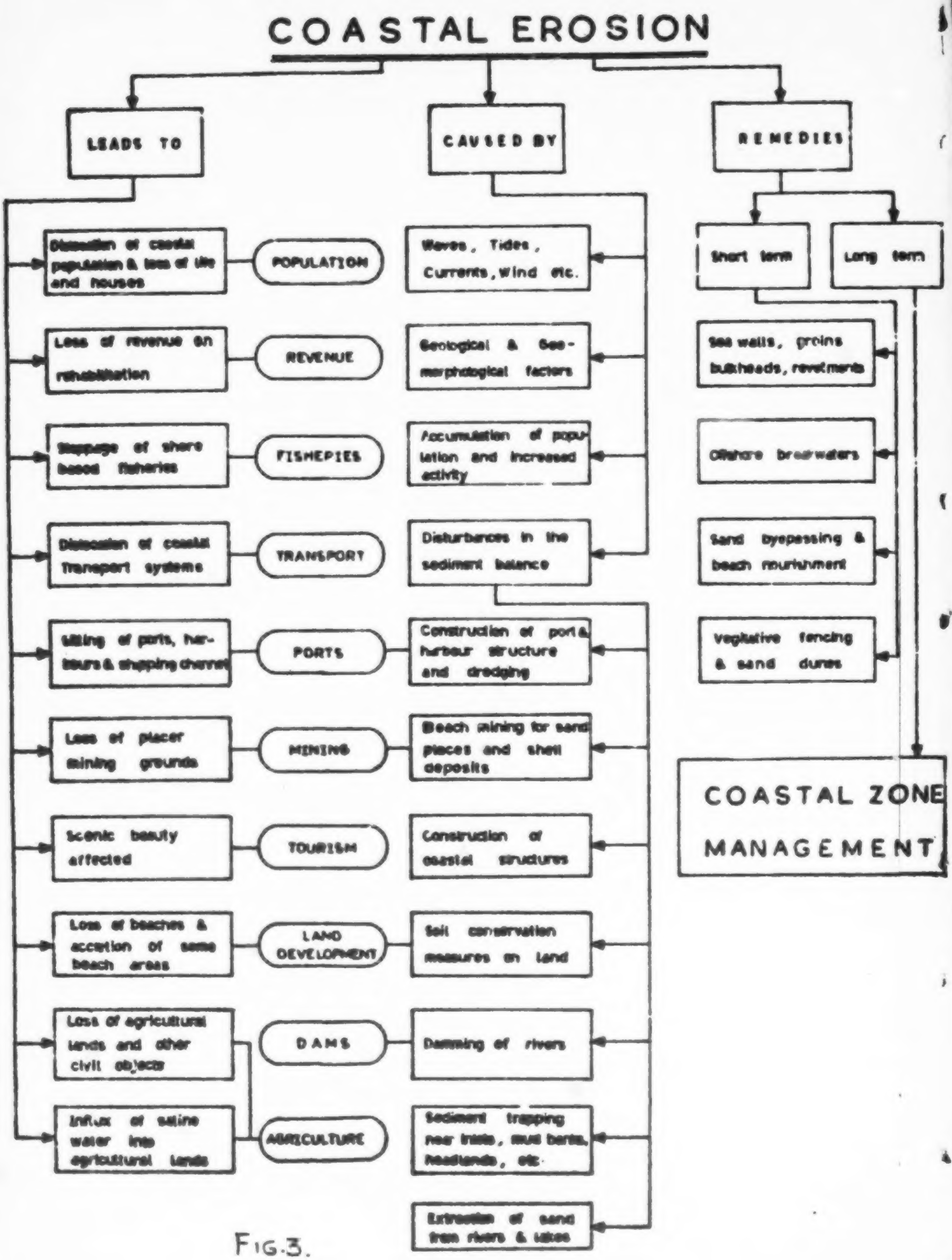
COASTAL EROSION
LEADS TO
CAUSED BY
REMEDIES
Dislocation of coastal population & loss of life and houses
POPULATION
Waves, Tides, Currents, Wind etc.
Loss of revenue on rehabilitation
REVENUE
Geological & Geo-morphological factors
Stoppage of shore based fisheries
FISHEPIES
Accumulation of population and increased activity
Dislocation of coastal Transport systems
TRANSPORT
Disturbances in the sediment balance
Silting of ports, harbours & shipping channel
PORTS
Construction of port & harbour structure and dredging
Loss of placer mining grounds
MINING
Beach mining for sand places and shell deposits
Scenic beauty affected
TOURISM
Construction of coastal structures
Loss of beaches & accetion of some beach areas
LAND DEVELOPMENT
Soil conservation measures on land
Loss of agricultural lands and other civil objects
DAMS
Damming of rivers
Influx of saline water into agricultural lands
AGRICULTURE
Sediment trapping near inlets, mud banks, headlands, etc.
Extraction of sand from rivers & lakes
Short term
Long term
Sea walls, groins bulkheads, revetments
Offshore breakwaters
Sand byepassing & beach nourishment
Vegitative fencing & sand dunes
COASTAL ZONE MANAGEMENT

FIG.3.

intensive coastal erosion include loss of valuable beaches and agricultural land, washing away of houses and other civil objects dislocating the coastal population, loss of revenue which is spent on their rehabilitation, stoppage of fisheries and other navigational activities, silting of ports and harbours,influx of saline water into agricultural lands damaging the crops etc. (Fig. 4). Some structural measures are being adopted to arrest the erosion. It is observed that these measures are not enough to solve all the problems mentioned avove, because they are inefficient in some coasts and they endanger the natural sediment drift (Baba 1979b), which is essential to maintain the coastal sediment balance. In many places they obstruct the fishing activity and also the aesthetics of the coast, which is an important factor when we think in terms of the tourism development potential of the coast.

Causes of coastal erosion are attributed not only to the direct parameters such as waves, currents, tides, geomorphology, geological properties of the coast and sediments etc., but also to indirect factors such as deficiency in sand supply to coasts due to (a) construction of ports and harbours, (b) construction of reservoirs in rivers, (c) dredging activity at the river mouths, estuaries and backwaters, and (d) other obstacles in the coast such as seawalls, groins, sewage pipelines, river outlets, mud banks, head lands and others (Baba 1979b). Also other pressures on the coastal zone like the accumulation of population in one area, which may be due to (a) the intensive fishing in the area, (b) the inability to live in some particular areas due to high pollution, flooding or inaccessibility or (c) any other commercial, social or geographical reasons, lead to unbalancd developmental activities which may disturb not only the geographical balance but also the equalibrium of the neighbouring beaches causing their erosion or accretion. The intensive dredging of beach sands for minerals (e.g., Chavara) and reclamation (e.g., Andhakaranazhi, Tellicherry, etc.) purposes is also attributed to as one of the reasons for erosion.

If we take all the above situations which are peculiar to the Kerala State, into consideration, it can be seen that the problem of coastal erosion cannot be solved by structural methods alone (Watts 1965, Kurup 1974, Baba 1979b, 1981a, Moni 1981). This problem is closely related to the fishery industry, mining industry, harbour dvelopment, housing and agricultural patterns, transport systems and others (Fig. 4). So the solutions can be achieved only through a management programme with the following broad objectives:

(a) Solve the existing problems of this zone such as erosion, housing, pollution, overfishing, over-concentration of population confining all the developmental programmes to one place simultaneously;

(b) prevent future problems through proper planning;and

(c) plan exploitation of the coastal resources without damaging the coastal environment.

Budget Allocations and Conflicts Achieved

The vastness of the proble and the jusification for a management programme can be understood by the budget allocations made by the Governmnt of Kerala and the Government of India on different aspects related to the coastal zone (Table 1). In the sixth five-year plan period of 1978-83 the Kerala Government had plans to spend approx. Rs. 140 crores on this zone of the total outlay of Rs. 2000 crores for the plan period. This amount does not include more than Rs. 107 crores spent by Government of India in this coastal zone.

At this point the question being asked is whether these investments are achieving the required goals? These investments and the implementing agencies do their job within the sphere of their activity. There are hundreds of agencies and departments under the local bodies, State and Central Governments working in the coastal zone (Table 2) addressing to various problems. Very often, these agencies have conflicting responsibilities or overlapping jurisdiction. For example, the State P.W.D. (with great enthusiasm) try to protect the eroding fragile beaches, which, they are not sure, how long will be protected by the present protection measures. In the meanwhile, the Revenue Department and the Fishermen Welfare Corporation issue land deeds and construct houses respectively on this fragile beach land to the illiterate coastal community. On another front the Government of India is mining for rare earths and constructing national highways on the beaches, without much concern about the harm it does to the delicate equilibrium of the beaches or without examining th ways by which to restore the beaches, or without any concern about the subsequent damage to these interests themselves in foreseeable future in the absence of beaches.

The Need for Management

The relevance of a Coastal Zone Management Programme is to be viewed in this context. Taking into account various agencies involved in themanagement of the different aspects of the coastal zone, the functions of the Coastal Zone Management Policy should be to correct two fundamental short comings of the present management or regulation systems. These are (i) lack of overall coordination of the regulatory authorities that are already in existence, and (ii) inadequate consideration of coastal resources and their use constraints in the decision making process (Brahtz 1980). Correction of these basic management difficiencies should, in turn, greatly facilitate the solution of many specific problems and lead to the overall development of the coastal zone.

With the diversity of the problems and their multidisciplinary nature. the coastal zone management may have to be viewed more as an environmental rather than an engineering problem.

Any area having many conflicts over different uses within it requires an efficient management programme to designate priorities and assure balanced development with least damage to individual units.

COASTAL ZONE MANAGEMENT PROGRAMME FOR KERALA

The planning and management of the coastal zone provide facilities for conservation of coastal resources. its balanced exploitation, overall development and a net economic growth of the state and the country as a whole. For example. the U.S.A. passed a Coastal Zone Management Act in 1972 to provide federal incentives to States and Local Goverments to develop and then implement effective Coastal Zone Management Programmes (Baba 1985a). This has helped various states there to reduce the conflicts considerably and to plan balanced development of the coast (Washom 1974). Similar programmes have been implemented by many other countries like France. Australia, Finland, USSR and Japan.

Aims and Objectives

Coastal Zone Management Policy for ~~the~~ Kerala coast should have the following aims:

i. To enact necessary policies and legislation to control various uses of the coast and for the balanced development of the coastal zone with maximum benefit to the coastal population and maximum protection to its environs:

ii. To coordinate the activities of existing local. State and central implementing agencies. without enforcing any changes in their prevent jurisdiction, but to uphold total cause of the coastal zone as laid down in the policy.

The policy thus adopted for the management of the coastal zone will have thefollowing broad obbjectives:

- Prevention of coastal erosions:
- Beach front protection and developement:
- Mining of sand for beach nourishment and reclamation:
- Pollution control:
- Conservation of ecosystems:
- Protection of life and property:
- Control of development:
- Development and management of water. minerals. fisheries and other coastal resources:
- Port and harbour dvelopment:
- Development of coastal land:
- Housing development:
- Recreational and tourism development:

- Controlled dvelopment of coastal wet lands;
- Development and management of coastal waterways;
- Development of land transport systems;
- Energy development and transmission schemes

DEVELOPING A COASTAL ZONE MANAGEMENT POLICY

In order to manage the coastal zone, a policy may have to be drafted. In this, the coastal boundaries, areas requiring particular attention and the agencies to be involved have to be identified and then a draft prepared for the approval of the State and Central Governments.

i. Coastal Boundary:

The seaward and landward boundaries of the coastal zone may have to be damarcated first. The seaward boundary may be fixed so as to incorporate the entire territorial waters bordering Kerala State. The landward boundary may have to be decided more judiciously, as it involves maximum uses to be managed and conflicts resolved. Three alternatives are proposed.

1. to include the entire area demarcated as lowland, i.e. below 8 m elevation, or
2. to include the three municipal corporations, the twelve coastal municipalities and all the coastal panchayats, or
3. as in case of Connecticut s coastal boundary (Connecticut CZM Program, 1978), to cover the areas whose management is necessary to control uses which have a direct and significant impact on coastal waters, coastal areas of particular concern (see below for detailed description), waters containing a significant quality of seawater, salt masches and wetlands, beaches, intertidal areas, areas subject to wave induced flooding and areas containing vegetation that is salt tolerant and saltwater dependent and islands.

Among the three, the first two may be convenient from the physiographic or administrative sense, but may have the drawbacks that it contain areas, which do not have any relation to the coastal activity; some areas which are on the coast, but do not get included (e.g. islands, coastal cliffs, promontories etc.) or the area is too large to bring under a management program. The third alternative appears to be more adaptable from the viewpoint of environmental protection of the coastal zone. It may also be possible to adopt a two tier system (Connecticut's CZM Program, 1978) in which to deal the major management issues the boundary based on the third alternative and for some selected broader and low priority issues, the second alternative are chosen.

However, a detailed study may be required before arriving at a conclusion as regards to the coastal landward boundary. In deciding this the objectives of the CZM program have to be kept in view along with the administrative and funding capabilities of the governments, local bodies, etc.

ii. Areas of Particular Concern:

Under any coastal zone management program, it would be convenient and more advantageous, if specific areas having conflicts over different uses, are given top priority and special attention. In identifying these areas, the social, economic and ecological factors may provide the major guidelines. Areas having very high density of population, areas affected by intensive beach erosion, places where intensive dredging and reclamation activity is undertaken or planned, highly polluted environs, areas with a significant impact on ecosystems, areas of high historic and recreational value threatened of annihilation, etc., may be considered for this.

In order to have a rational assessment in the selection of areas of particular concern, a scientific study may be required. Proper care has to be taken to see that these decisions are made based only on the above study and not under other socio-political pressures.

iii. Existing Coastal Regulatory Agencies and Their Functions:

One of the major aspects to be dealt with in framing a policy is the role of the existing agencies in the successful implementation of the coastal zone management programme. It may be remembered that, there are all essential regulations and implementing departments or agencies, even at present, with the major drawback that each of them attend to their individual tasks. This creates considerable conflicts and restraints in the use of coastal resources and facilities. So, an optimum utilization is required of all these local bodies, departments, corporations, judiciary etc., with proper coordination to the maximum benefit of the coastal zone. Hence before framing a policy, it is necessary to study the existing administrative and management facilities, their areas of activity, regulations presently available, areas where they fail to achieve the desired objectives, and loopholes, etc.

iv. Preparation of a Policy Document:

Taking into account the results of these studies and the aims and objectives of the coastal zone management program, a policy statement with all necessary details may have to be drafted. The draft policy statement may be widely circulated among the related government and private agencies and also the general public, especially the coastal population. Based on the reports, comments and criticisms from various sources, the draft may be suitably amended and passed by the legislature.

For any such management program, the interests of the central government also have to be looked into. The additional

Table 1. Sixth 5-year plan budget for Kerala 's Coastal Zone

Purpose		Amount (in crores Rs)
Government of Kerala		
Anti-sea erosion works		45.0
Marine fisheries and related programmes		55.0
Ports and harbours		18.5
Tourism and others		20.0
	Total	138.5
Government of India		
Coastal canal systems		7.0
Cochin Port		100.0
Mineral exploration and mining		
Coastal railway		
Coastal highways		
Housing		
Agriculture and others		
	Total	107.0
	Grand Total	245.5

Table 2. Major agencies involved in the activities of Kerala's Coastal Zone

No.	Department/Agency	User	Develop-ment	Studies	Others
1.	Dept of Revenue	x			x
2.	Department of Fisheries	x	x	x	
3.	Dept of Industries	x		x	
4.	Dept of Mining & Geology	x		x	
5.	Dept of Ports	x			
6.	Dept of Harbour Engineering		x	x	
7.	Dept of Public Works	x	x	x	
8.	Dept of Transport	x			
9.	Dept of Agriculture	x			
10.	Dept of Irrigation		x		
11.	Dept of Local Administration	x	x		
12.	Various Industries	x			
13.	Local bodies	x	x		x
14.	Greater Cochin, Trivandrum & Calicut Develop. Authority	x	x		
15.	Indian Navy	x	x	x	x
16.	Kerala Fisheries Corporation	x	x		
17.	Kerala Fisherman Welfare Corp.		x		
18.	Water and Wastewater Authority		x		
19.	Kerala State Pollution Control Board			x	x
20.	Ground Water Board		x	x	
21.	Centre for Earth Science Studies			x	
22.	Centre for Development Studies			x	
23.	Dept of Atomic Energy (India)			x	
24.	Cochin Port Trust	x	x	x	x
25.	Central Marine Fisheries Research Institute			x	
26.	Central Inst. of Fish. Technol.			x	
27.	National Inst. of Oceanography			x	
28.	Kerala and Cochin Universities			x	x
29.	National Highways	x	x		
30.	Railways	x	x		
31.	Various Service Societies & Clubs		x	x	x

expenses for administration, investigation, specific developments etc., may have ato be provided by the Central Government. For this, a spcial agency and funds may have to be created under Department of Environment or/and Department of Ocean Development of the Governmnent of India, with appropriate policies, suggesting major guidelines to the states. Necessary recommendations may have to be made to the Centre for the adoption of necessary policies in this regard. The CZM policy passed by the State legislature may have to be got approvd by the Governmnent of India to become law.

IMPLEMENTATION OF A COASTAL ZONE MANAGEMENT PROGRAM

To implement this policy, a suitable Coastal Zone Management Authority (CZMA) with statutory powers may be established. The major responsibility of CZMA will be to co-ordinate the user, implementing and investigting agencies (Table 2) for the implementation of the policy. The major local implementing agencies would be the municipal corporations, municipalities, panchayats and other local agencies. These bodies issue the permits for various uses and development programmes in their respective areas as it is done now, following the guidelines issued by the CZM authority. Only issues and disputes, which cannot be managed by these agencies will come to the CZMA. Also major or/and long-term uses, issues and programmes will be referred to the CZMA who will recommend suitable guidelines, based on detailed investigations to the state or local agencies.

The CZM authority is authorised to receive/raise funds from the Central/State Governments, local bodies and other agencies. It will sanction funds for administrative, development and other purposes to the bodies and agencies involved.

The authority may be under a Comissioner and he may have subordinate personnel to look after administration, planning, co-ordination and investigation. If necessary, it may establish three regional offices to look after the matters of southern, central and northern coasts of the State.

The success of a coastal zone management programme depends mainly on the interest and cooperation of the coastal population. Hence large scale efforts may have to be made, if necessary through voluntary organizations working in the area and who have sufficient interest in the programme, in particular, and in the overall development of the state and the country.

CONCLUSIONS

The coastal zone of Kerala with its high population density, at places even more than 2000 persons per sq.km and with its limited resources, which are mainly non-renewable, faces severe problems like coastal erosion, pollution, saltwater intrusion, high rate of wetland reclamation and others. The rapid industrialization of certain areas, unscientific and haphazard developmental activities by various agencies, both governmental and private have led the coatal problems to a critical condition. Some potential uses of this coastal zone, such as waterways, tourism, energy sources, sand and offshore mineral resources, etc., remain untapped. Many of the coastal uses have overlapping jurisdiction which invite conflicts among the users and managers. Lack of coordination among these agencies and absence of a national/state policy are found to be the major hurdle in the conservation and development of the coastal zone of Kerala.

A Coastal Zone Management programme, with clear objectives, predrawn coastal boundaries and with the apriorities fixed has to be implemented through as CZM Authority. Under this programme the coordination of existing coastal user and regulatory agencies, under a properly laid down coastal zone policy on the lines of similar ones existing in various other coastal countries of the world, is envisaged. The management plans for each location will be drawn up by local authorities, which will be examined on the basis ofthe policy and will be approved by CZM Authority for implementation. With the cooperation of the coastal population the suggested Coastal Zone Management Programme is expected to take the coastal zone a long way in the optimal use of its resources, balanced development of it and in the overall improvement in the quality of coastal life.

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CASE STUDY OF SANDUR MINING AREA

R.G. Desai*

INTRODUCTION

From the modest beginning of 24 minerals during the pre-independence years, the Indian mining industry has come a long way and produced 64 minerals valued at Rs 26.83 billion. Among these minerals, iron ore estimated at 13.5 billion tonnes, is the second largest mineral resource. The annual production is around 39 million tonnes of which domestic consumption accounts for about 16 million tonnes and the rest is exported.

Such a large-scale mining operation in the country is looked only from the viewpoint of revenue and employment and its bad effects, not only to the topogrophy of the area and human health but also to flora and fauna are neglected. During blasting, drilling, loading and unloading of the ore, 'fines' and 'blue dust' are generated. Fines are usually not been effectively utilised due to lack of new technology and blue dust is not controlled due to apathy of the private mine owners. This results in environmental pollution and health hazards.

It is reported that for every tonne of ore, half of it will be reduced to fines. Simultaneously blue dust is generated, it is usually carried away by the wind and rain water, and results in the problems of air and water pollution. When air and water are polluted they cause a number of diseases and health hazards in the area. Health hazards associated with large scale mining operations are: darkness, climate, dampness, climatic conditions, radiation, presence of arsenic, gases, atmospheric pressure, traumatic accidents, noise, vibration, dust, radio isotopes, and biological risks.

However, in iron and managanese ore mining only few hazards are noticed viz., presence of dust, poisonous gases and other air borne and water borne impurities and accidents. These not only affect the health of many people in the area but also spread diseases. The diseases are called 'slow killers'.

The present study is a mild attempt to peep into the field of such slow killers in the Sandur area owing to large scale mining operations for the last 70 years. The specific objectives were:

a. to investigate the number of persons suffering from water borne and air borne diseases over a period of 5 years,

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b. to seek their trend in recent years, and
c. to suggest suitable control measures.

MATERIAL AND METHODS

Secondary data collected from the records of the Government General Hospital, Sandur, for the period from January 1978 to December 1982 were analysed. The percentage change in water and air borne diseases is compared to other diseases in the area. The chemical analysis of the water of Sandur area has been made by Dr. H.M. Jayaseela and others who concluded that water in Sandur area is not fit for drinking as it contains 2 to 3 % iron against the one percent norm fixed by World Health Organisation.

The data have been collected only from one Hospital at Sandur Town and exclused other hospitals of the nearby area. Further, the data cover only the outdoor patients and excludes the indoor patients. However, it does not restrict the scope of the study because indoor patients visit the hospital first as out-patients.

Study Area

Sandur is a small town in Bellary District of Karnataka, and has numerous hills and valleys of various dimensions. Sandur schist belt, 53 km long and spread over an area of 600 sq. km, is a treasure house for two important ferrous minerals, iron and manganese. Large scale mining is carried out for the last several years both by the public sector organisation (National Mineral Development Corporation) and private sector organisations apart from several small and medium mine owners.

RESULTS AND DISCUSSION

The number of diseases are categarised into 46 by the Directorate of Health and Family Planning, Bangalore and proforma is made available to all the Government General hospitals. Out of these 46 major diseases 20 diseases are noticed in the records of the Sandur Government General hospital. However we have taken for our study 19 major diseases excluding 'injuries' as it is not a disease in the strict sense of the term.

The major diseases from which maximum number of people suffered are mentioned in the Table 1. It reveals that maximum people are suffering from water and air borne diseases.

It is clear that the water and air in the Sandur area are polluted due to large scale mining operations. Therefore the mining operations in future has to be done with utmost care and provide sufficient safety measures.

The data further show (Table 2) that air and water borne diseases have affected more than 55% people. It is disheartening to note that such large number of people suffering from these

Table 1. Yearwise total number of patients suffering from various diseases in the study area (1978-82)

S.N.	Diseases	1978	1979	1980	1981	1982	TOTAL
1.	Tuberculosis	54	25	21	21	17	138
2.	Asthama	128	540	14	67	50	465
3.	Allergy	102	107	Nil	21	02	147
4.	URI	2053	1528	1064	2492	2422	9549
5.	Influenza	2531	1530	359	573	32	5024
6.	Branchitis	2491	1164	1251	1383	1051	7340
7.	Dysentary	831	1399	1364	1491	1330	6417
8.	Helmenthitis	231	740	804	1106	984	3865
9.	Diarrhoea	3842	1579	902	1207	768	8386
10.	Digestive Disorder	1029	934	550	780	409	3702
11.	Fever	3428	2725	2724	2338	1351	12566
12.	Anaemias	689	540	397	624	698	2948
13.	Conjunctivitis	572	832	629	705	761	3499
14.	Otitis	648	812	685	884	725	3750
15.	Teeth and Gum	584	283	343	619	572	2401
16.	Scabies	908	1067	988	1311	1178	5402
17.	Stomach-Ulcer	188	81	Nil	05	04	278
18.	Spondylitis	1354	676	970	504	511	3575
19.	Myalgia	53	13	224	364	453	1087

SOURCE: Figures computed from the office records of Government General Hospital, Sandur.

slow killers are provided with little care.

An interesting finding is that while the air and water borne diseases are declining slowly from 60% in 1978 to 50% in 1980 and slightly increased to 53% in 1982, other diseases sharply increased from 40% in 1978 to 50% in 1980 and then slightly decreased to 47% in 1982.

Remedies Suggested

Mining and processing of mineral resources may have a considerable impact on the land, water, air and biological resources. The impact is part of the price we pay for the benefit of mineral consumption and it is unrealistic to expect that exploitation of natural resources can be accomplished without affecting some aspect of local environment. What must be done is to develop resources with the minimum of adverse impact. In the Sandur area adverse effects may be minimised if the following measures are undertaken.

1. In cases of haul roads and stockpiles etc., dust can be con-

Table 2. Disease-wise distribution of patients in the study area
Figures in perentheses refer to percentage.

Diseases	1978	1979	1980	1981	1982
A. AIR BORNE					
Tuberculosis	54	25	21	21	17
Asthama	128	540	14	67	50
Allergy	102	107	-	21	02
URI	2053	1528	1064	2492	2422
Influenza	2531	1530	359	573	31
Bronchitis	2491	1164	1251	1383	1051
Total	7359 (32.7)	4894 (28.2)	2709 (21.7)	4557 (27.5)	3573 (26.8)
B. WATER BORNE					
Dysentery	831	1399	1364	1491	1330
Helmenthitis	231	740	804	1106	984
Diarrhoea	3842	1579	902	1277	768
Degestive Disorder	1029	934	550	780	409
Total	5933 (27.3)	4652 (26.7)	3620 (28.3)	4654 (28.1)	3491 (26.2)
C. OTHERS	3428	2725	2724	2338	135[illegible]
Fever	689	540	397	624	698
Anaemias	572	832	629	705	761
Conjunctivitis	648	812	685	884	725
Otitis	584	283	3453	619	572
Teeth and Gum	908	1067	958	1311	1178
Scabies	188	881	-	05	04
Stomach Ulcer	1354	676	470	504	511
Spondylitis	53	13	224	364	453
Myalgia	8424	7829	6430	7354	6253
Total	(40.0)	(45.0)	(50.0)	(44.4)	(47.0)
Grand Total	21716	17375	12759	16565	13317

SOURCE: Figures computed from the office records of Government General Hospital, Sandur.

trolled by proper maintenance and water spraying.
2. The residential buildings should be constructed to keep dust pollution to the minimum.
3. At present some roads are at the heart of the town. The number of lorries carrying ore to the Toranagallu Railway Station generate lot of dust resulting in air pollution. Hence separate roads for ore transport should be constructed outisde the vicinity of the town.
4. Plantation of trees may be taken up between the residential areas and mining areas. A dense vegetation will act as a screen to prevent dust.
5. Laws should be enacted to regulate dust and noise emissions in the area.
6. In order to utilise the disposed fines, the pellatisation plant should be installed. It is unfortunate that though such plant was proposed some years back at Donimalai, NMDC Project area, yet it has not come up.

Specific Measures

(1) Health hazards can be reduced by providing first-aid facilities at the work spot and proper care by preplacement and periodical checking.
(2) Frequent mine inspection should be undertaken to supervise the safety measures.
(3) The workers education, which inclueds health education and environmental monitoring should be given top priority.
(4) Water, particularly drinking water, in the Sandur Town should be purified by the Municipal Authorities before supplying it to the public. At present water is pumped directly to the tanks and supplied without purification.

The present study confirms our hypothesis that mining operations in the area have affected the health of the people, flora and fauna and created the siltation problem in the Narihalla Reservior of the area leading to ecological imbalances.

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ENVIRONMENTAL STRATEGIES FOR LIME WORKS: A CASE STUDY OF MAIHAR-KATNI REGION OF MADHYA PRADESH

K.C. Mathur, I.M. Shukla and R.P. Payasi*

With the increasing environmental awareness, air pollution problems, even of small areas have attracted attention of planners and general public. In Madhya Pradesh, Satna-Maihar-Jhukehi-Katni belt situated in north-eastern part of the State, is rich in limestone deposits and the area is actively engaged in lime manufacture for the last five decades. There are 11 major industries having 37 kilns at Maihar, 12 factories with 52 lime kilns at Jhukehi and 30 kilns in Katni. Labour population engaged in the above lime works is about 6000. On an average estimate, 30 kilns produce 700 tonnes of lime using 200 tonnes of coal and 730 tonnes of limestone per day, and release 7000 to 14000 kg sulphur dioxide besides the particulate pollutants. The studies conducted by Mathur et al. (1983-84) in Maihar-Jhukehi (Katni) region indicate the SO production in the area to be between 10-20 tonnes. Besides, the dust fall and suspended particulate matter (SPM) are estimated at 1.86 mg/m /month.

The sulphation rate at Maihar is 0.005 g suphur in SO_2/ 100 cm^2/day, and at Jhukehi it is even more (0.015 g) which show that these areas are highly polluted by SO gas.

Most of the lime kilns are situated on the highways and cause loss of visibility when the production is in full swing. Reduced visibility is related to size, concentration and physical characteristics of particulate pollutants present. Solids and liquid when airborne scatter and absorb light. Visibility is dependent upon the transmission of light which is affected by the presence of smoke, dust and soot, etc. It is estimated that visibility loss across highways and railway tracks due to lime works is between 75-100% during day time which is a matter of concern for road and rail accidents.

It is known that SO_2 along with SPM from lime kilns is responsible for affecting plant life. Chlorophyll content in leaves of trees and shrubs is reduced in stistically correlated ratios. Plants like Azadirachta indica, Madhuca indica, Eucalyptus sp., Butea monosperma and Mangifera indica have suffered an accountable chlorophyll loss. These are dominant plant species in Jhukehi and Maihar area.

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Water quality has also been adversely affected due to constant release of gaseous and particulate pollutants. The physico-chemical parameters have been drastically enhanced more than the ISI standards. The average hardness ranges between 400 and 600 mg $CaCO_3$/litre. SO_4 content ranges between 150 and 500 mg/litre, pH has been altered to 8.0 to 9.0 level, total solids range from 650 to 6000 mg/litre and calcium content is 150 to 700 mg/litre. These figures explain themselves the effect of air pollution on water bodies.

In another study on the effects of lime works on human health, Mathur et al. (1983) observed that 30-50% of the population around the area suffers from respiratory disease, 1-3% from tuberculosis, 5-12% skin diseases, 3-15% from gastro-intestinal disorders.

Environmental Strategies for Lime Works

In light of the studies in Maihar-Jhukehi area, it has been thought worthwhile to plan an environmentally ideal situation for lime works. The Air Pollution Act although restricts the present type of manufacturing process of lime works, yet many factors like cost benefit ratios, public interest and labour availability restrict the industrialists to shift their lime kilns to remote areas or to stop production. Based on above considerations, following strategies are suggested for lime works:

1. Lime works situated on either side of highways and railway tracks should be immediately shifted to remote places to prevent further accidents.
2. Height of the kilns should be increased from 30 to 40 ft.
3. Scrubbers should be used to trap gaseous and particulate pollutants, a practice which is not used so far.
4. Before giving permission to any lime works, heavy plantation programme should be undertaken, which will be useful in checking pollution.
5. The planners must not allow any housing colonies in 3 to 5 km area around the lime kilns.
6. Lime kilns should not cluster in one area to avoid building up concentration of air pollutants.
7. Environmental Impact Studies should be taken up immediately.
8. Drinking water bodies should be covered and must not come in contact with air pollutants.
9. Health survey of labour engaged in the lime works and the surrounding population should be made periodically.
10. An environmentally better design should be devised.

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CONSERVATION AND MANAGEMENT OF WILD MAMMALS OF KERALA

M. Balakrishnan*

INTRODUCTION

The need for conservation of India's natural habitats and thereby protecting various plant and animal species had been stressed recently by Gadgil (1979, 1982), Ananthakrishnan (1980), Sharma (1981), Swaminathan (1981) and Khoshoo (1984). Tropical forest ecosystems are known for their rich flora and fauna. At present, India has about 350 species of wild mammals in different forest habitats. It is alarming to note that 81 of these are threatened with extinction (Saharia 1982, Balakrishnan and Alexander 1984).

In addition to the wild mammals, India has a priceless legacy of other forms of wildlife such as birds, reptiles, amphibians, and a number of species of insects which are yet to be identified. Further, a number of other invertebrates and lower groups of vertebrates also inhabit various forests of India. However, studies on these forms are meagre as compared to some of the other regions such as East Africa, North America, etc. India is slower in acquiring expertise and advanced training in forest and wildlife management.

Kerala has about 9,000 sq. km of forests, consisting of west coast tropical evergreen and semi-evergreen, southern secondary moist mixed deciduous, southern montane wet temperate, marshy area and grasslands. These are further classified into specific types of forests based on the diversity of the composition of species (Champion and Seth 1968). Indiscriminate encroachment in these habitats resulted in the depletion of forests in extent and quality. At present, Kerala has twelve wildlife sanctuaries and two national parks comprising of about 2419 sq. km area (Table 1) where the prestigious wild animals have been protected.

Larger Mammals of Kerala

About 40 species of large and medium sized mammals are seen in the forests of Kerala (Table 2). Only a few of them have a viable breeding population. Others are either endangered or vulnerable. The lion tailed macaque, Macaca silenus (Fig. 1) and the Nilgiri tahr, Hemitragus hylocrius (Fig. 2) are the most endangered mammals endemic to South India. Population of the tiger,

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Table 1. Wildlife Sanctuaries and National Parks in Kerala

	Name	Area, sq. km
1.	Periyar Tiger Reserve	777
2.	Wynad Sanctuary	344
3.	Parambikulam Wildlife Sanctuarz	285
4.	Neyyar Wildlife Sanctuarz	128
5.	Peechi - vazhani Wildlife Sanctuary	125
6.	Idukki Wildlife Sanctuary	70
7.	Peppara Wildlife Sanctuary	53
8.	Thettekadu Bird Sanctuary	25
9.	Aralam Wildlife Sanctuary	5.50
10.	Chimmony Wildlife Sanctuary	10.00
11.	Chinnar Wildlife Sanctuary	90.44
12.	Shenduarney Wildlife Sanctuary	10.03
13.	SilentValley National Park	400.00
14.	Eravikulam National Park	97.00
	Total area, sq. km	2419.97

Panthera tigris, and the Asiatic elephant, Elephas maximus have also dwindled considerably during the recent past. In response to the evolutionary process, certain species should become extinct and certain others should evolve with the passage of time. Further, population of any species may dwindle after attaining a maximum growth due to diverse biological reasons. However, as compared to the rapid rate of extermination of certain species of animals to the natural extinction, the latter is very slow. Those species decimated rapidly in the recent past happened to be costly in one way or the other by virtue of their edible flesh, costly horns, beautiful fur or feather, and so on (Balakrishnan and Alexander 1984).

Conservation of Forests and Wildlife

Conservation of wildlife can be achieved only by the protection and preservation of natural. forests. Although immediate benefits could be achieved by adopting unscientific extraction of forest produce and by various developmental activities on short-term basis, only scientifically oriented action programmes would yield long-term benefits of forests at a constant rate. In addition to the salient role played by forests in the maintenance of climate, soil moisture, control of soil erosion and floods, forest and wildlife are beneficial to us by preserving the ecosystem, maintaining resistant gene pools, safeguarding environmental qualities and by way of constant supply of forest produce.

Table 2. Large and medium sized Wild Mammals of Kerala*

S.N.	Species	Family	Habitat
1.	Indian Flying fox or the Greater Indian fruit bat, *Pteropus giganteus* (Brunnich)	Pteropidae	Semi-evergreen and deciduous forests
2.	Fulvous fruit bat or Rousette bat, *Rousettus leschenaulti* (Desmarest)	Lorisidae	Evergreen, semi-evergreen and deciduous forests
3.	Slenderloris, *Loris tardigradus* (Linnaeus)	Cercopithecidae	Deciduous forests and village surroundings
4.	Bonnet macaque, *Macaca radiata* (Geoffroy)	Cercopithecidae	Evergreen forests
5.	Lion-tailed macaque, *Macaca silenus* (Linnaeus)	Cercopithecidae	Dry deciduous forests
6.	Common langur or Hanuman monkey, *Presbytis entellus* (Dufresne)	Cercopithecidae	Evergreen, semi-evergeen and deciduous forests
7.	Nilgiri langur, *Presbytis johni* (Fischer)	Felidae	Grasslands, evergreen and deciduous forests
8.	Tiger, *Panthera tigris* (Linnaeus)	Felidae	Evergreen, semi-evergreen and deciduous forests
9.	Leopard or the Panther, *Panthera pardus* (Linnaeus)	Felidae	Deciduous forests and grasslands
10.	Leopard cat, *Felis bengalensis* (Kerr)**	Felidae	Dry deciduous and scrub forests and grasslands
11.	Fishing cat, *Felis viverrina* (Bennet)**	Felidae	Grasslands, and scrub jungle
12.	Rusty spotted cat, *Felis rubiginosa* (Geoffroy)**	Felidae	Scrub jungle, grasslands, semi-evergreen and deciduous forests

13. Jungle cast, *Felis chaus* (Guldenstaedt)	Viverridae	Evergreeen and semi-evergreen forests and grasslands
14. Small Indian civet, *Viverricula indica* (Desmarest)	Viverridae	Evergreen, semi-evergreen and deciduous forests
15. Malabar civet, *Viverra megaspila* (Blyth)**	Herpestides	Deciduous forests and grasslands
16. Common Palm Civet or the Toddy cat *Paradoxurus hermaphrodiatus* (Pallas)	Herpestidae	Deciduous forests and grasslands
17. Common mongoose or Indian Grey Mongoose, *Herpestes edwardsi* (Geoffroy)	Herpestidae	Deciduous forests
18. Ruddy mongoose, *Herpestes smithi* (Gray)	Canidae	Deciduous forests and grasslands
19. Striped-necked mongoose, *Herpesrtes vitticollis* (Bennet)	Canidae	Scrub forests and open country
20. Asiatic Jackal, *Canis aureus* (Linnaeus)	Canidae	Grasslands, evergreen and deciduous forests
21. Indian fox or the Bengal fox, *Vulpes bengalensis* (Shaw)	Ursidae	Grasslands, and deciduous forests
22. Dhole or the Aisatic Wild dog, *Cuon alpinus* (Pallas)	Mustelidae	Hill and mountain streams, lakes and rivers
23. Sloth bear, *Melursus ursinus* (Shaw)	Mustelidae	Lakes, streams and canals
24. Otter or the Eurasian Otter, *Lutra lutra* (Linnaeus)	Mustelidae	Deciduous forests and grasslands
25. Smooth Indian Otter, *Lutra perspicillata* (Geoffroy)	Suidae	Grasslands, marshy areas and deciduous forests
26. Nilgiri marten or South Indian Yellow-throated Marten, *Martes quatkinsi* (Horsfield)	Tragulidae	Evergreen, semi-evergreen and deciduous forests

27. Indian Wild bear, *Sus scrofa* (Linnaeus)	Cervidae	Grasslands and deciduous forests
28. Indian Chevrotain or Mouse deer, *Tragulus meminna* (Erxlaben)	Cervidae	Deciduous forests
29. Sambhar, *Cervus unicolor* (Kerr)	Cervidae	Evergreen, semi-evergreen and deciduous forests & grasslands
30. Chital or the spotted deer, *Axis sp.* (Erxleben)	Bovidae	Deciduous forests and grasslands
31. Indian Muntjak or the Barking deer, *Muntiacus muntjak* (Zimmermann)	Bovidae	Rocky grasslands
32. Gaur, or the Indian Bison, *Bos gaurus* (Smith)	Elephantidae	Grasslands and deciduous forests
33. Nilgiri tahr, *Hemitragus hylocrius* (Ogilby)	Sciuridae	Evergreen, semi-evergreen and deciduous forests
34. Indian elephant, *Elephas maximus* (Linnaeus)	Sciuridae	Evergreen, and deciduous forests
35. Malbar Giant squirrel, *Ratufa indica* (Erxleben)	Sciuridae	Evergreen, semi-evergreen and deciduous forests
36. Small Travancore Flying squirrel, *Petinomys fuscocapillus* (Jerdon)	Hystricidae	Grasslands and deciduous forests
37. Large brown flying squirrel, *Petaurista petaurista* (Elliot)	Leporidae	Grasslands and deciduous forests
38. Indian Porlcupine, *Hystrix indica* (Kerr)	Manidae	Moist deciduous forests
39. Indian hare, *Lepus nigricollis* (Cuvier)	+	
40. Indian Pangolin, *Manis crassicaudata* (Gray)	+	

** For details on food habits, refer Balakrishnan 1984c.

+ The author has not seen these species in the wild habitat.

Encroachment, forest plantations, hydroelectric projects, poaching, fishing, collection of minor forest produce, forest fire, cattle grazing, tourism and pilgrimage are the majaor identified threat to the forest habitat and wildlife in the Western Ghats of Kerala (Balakirshnan and Easa 1982). Further, unscientific planning in the construction of roads, especially through the high ranges also resulted in the deterioration of forest habitat in Kerala. The recent landslides in Wynad ghats revealed the same. Although scientifically oriented planning may be more expensive initially, we have to adopt such methods in all our developmental activities (Figs. 3-5) which would be more beneficial and less expensive on long-term basis.

Table 2 shows that various forest habitats in Kerala have differentially been preferred by the diverse species of large and medium sized mammals. Hence each of these habitats must be protected to conserve andmaintain the animals depend on the forest type concerned. Gadgil (1982), Balakrishnan (1984a) and Balakrishnan and Easa (1985) have also stressed the need for protection of all the habitats in any forest area as an integrated unit for a better protection and conservation of species diversity.

Advanced Training in Forestry and Wildlife

Although India has the third largest force of scientific and technical personnel in the world, we have only limited number of them trained in forestry and wildlife. None of the Indian Universities has at present a separate department so as to facilitate advanced teaching research and training in forestry and wildlife. Hence considerable hardship has been caused to the forest and wildlife managers who are interested in higher studies. Even if they get admission in some of the foreign universities, they seldom get opportunities for a study relevant to the needs of Kerala or India in general. To overcome these difficulties, it is essential to create separate teaching and research departments either in selected Universities or in Forest Research Institutes, so as to create an active group of researchers in this fast developing field of biological sciences for a better conservation of our priceless forests and prestigious wildlife.

Research Programmes

In India, research activities in the field of wildlife biology and conservation of nature and wildlife are still in itsinfancy. Our research organisations such as the Bombay Natural History Society and Zoological Survey of India are mainly dealing with population ecology of a number of species. This gives us fundamental idea about the status of the species concerned by which we group them as 'extinct' 'endangered', 'vulnerable' and 'common'. Further a study on the population ecology also benefits us to know about the population fluctuation, growth rate, etc. in relation to habitat alteration (Balakrishnan and Alexander 1984).

Recent advances in the field of ethology could reveal the relevance of behavioural studies in wildlife management and conservation (Balakrishnan 1948b). Identified topics in ethology, especially the habitat preferences, feeding behaviour, social behaviour, reproductive behaviour and communication signals of various animals species play significant role for a better understanding of the species concerned (Balakrishnan and Alexander 1984). Thus it would help us in wildlife conservation in general and species preservation in particular. Hence, in addition to the population studies, behavioural biology of selected wildlife species needs to be investigated with a time bound programme. Further deer farming can also be initiated in selected forest areas in Kerala which will help substantially to overcome protein difficiency of the human population of villages in the high ranges (Balakrishnan 1984b). Crop insurance programme would also influence the public, who actually suffer from 'crop raiding' and 'cattle lifting', in diverting their creative activities towards the protection of wildlife.

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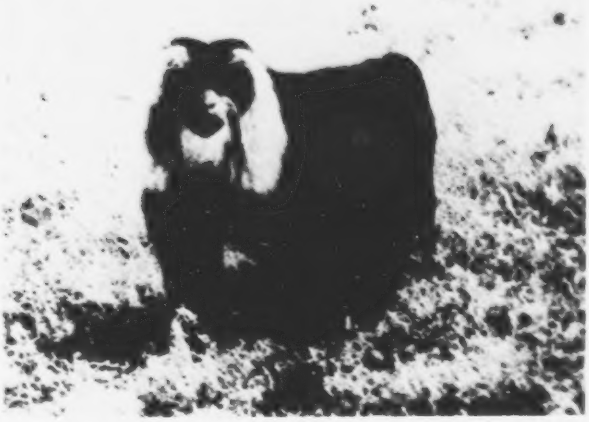

Fig. 1. A full grown Lion-Tailed Macaque (Photo by K. Wothe)

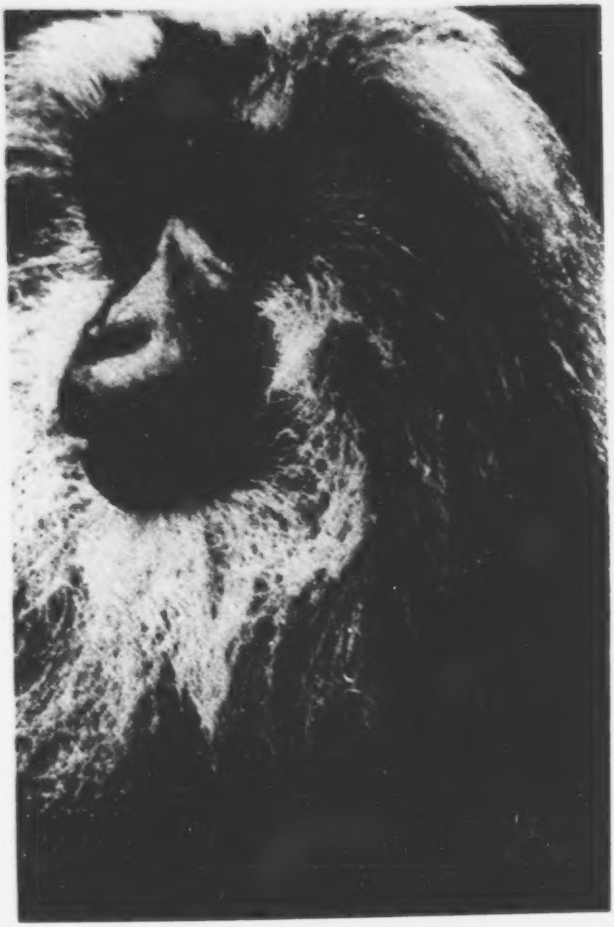

Fig. 2. A close-up of Lion-Tailed Macaque showing facial features

Fig. 3. The Nilgiri tahr. Hemitragus hylocrius

Fig. 4. A national Highway in Lausanne. Switzerland

Fig. 5. A view of forest, agricultural and grazing areas in a field in West Germany. Forests and agricultural areas are separated from the grazing fields by a simple and less expensive fencing using ordinary wooden poles with exposed live wires of low voltage to keep the cattle away.

CONSERVATION OF UNDEREXPLOITED PLANT RESOURCES

Promilla Kapoor*

During biogeographical history and evolution biological diversity of species came to be concentrated in tropics, and now this bio-resource is in danger of extinction for a variety of reasons. Lack of conservation in planning has now led to increase in wasted lands as living habitats are increasingly manipulated for limited or short-term purposes; Habitats are even being destroyed as space is given over to either alternative uses or is overexploited and polluted. This demands urgent ecological awareness in the conservation of bio-resources.

Of an estimated 30 million species on earth only one sixth have been identified and authenticated mainly in the past 200 years. Only 250,000 species of the total stock are plants. The wild species are of considerable potential benefit to man in medicine, agriculture and industry, as a source of natural product for drugs, food, fuels, fibre, industrial base compounds and additives. In agriculture, the productivity of major crops cannot be maintained let alone expanded, without a constant infusion of fresh genetic variability. Much of this genetic material comes from wild relatives of modern crop plants.

In addition, wild species offer considerable potential for entirely new foods. Of a global total of some 80,000 edible plants, only about 150 species have ever been cultivated on a large scale, and 90% of the world's food is produced from less than 20 species. Many examples of underexploited plants exist, with proven potential for future exploitation. In medicine lesser known plants are used for the production of many drugs and pharmaceuticals; one in four products sold in modern pharmacies originate from such underexploited wild plants resulting in a global commercial value of about $10 billion a year. In industry, plants are used across a wide spectrum. Scientists have only conducted a cursory screening of one in ten, and an intensive screening of one in a hundred. Thus an analysis of 250,000 plant species would reveal many new materials of benefit to mankind.

The screening of indigenous, underexploited food plants to supplement the much needed nutritional value and production of principal cereals is gaining importance both in national and international agricultural policies today. Obviously, it is desirable that such plants have high production potential and nutritive value and less dependence on the dwindling fossil fuels. From earlier exploration of such plants which are being used by local people for food in hilly areas in India, a list is now available (Kapoor 1978, 1983). An exhaustive study on one of these species has shown that some of these plants are cultivated as crop even today by many hill communities.

To emphasise importance of conserving underexploited plant resources an exhaustive study of one such species has been undertaken. Thus, studies conducted on grain chenopods revealed variability in the biological material to be sealed to ethnoecological characteristics of their environment of occurrence. Four kinds of grain chenopods were distinguished based on colour of seeds. It was observed that the cultivation of this crop is restricted to elevation range of 1500-3000m. Low income of the family and altitude of the locality where the families live are significantly correlated with chenopod crop cultivation. These grains are consumed by 30-50% families in a village. Higher consumption is noted in winter season. Grain is also used for alcoholic fermentation. The non-domesticated forms are also eaten. Chenopods are predominantly grown in mixed cropping and companion cropping. Pure cropping is rare. Several other crops grown in association with chenopods are finger millet, rice, pulses, potato. There is a close reference of chenopod cultivation, consumption patterns etc. in local folk songs and folklore. The ethnobotanical studies showed that chenopod grains are a vital food source of a large proportion of the hill community of Himachal Pradesh. This crop needs major improvements in seed quality, yield and commercial exploitation to revive its cultivation.

This pseudocereal possesses high potential for better yield and nutritive value. The plants possess many attributes required for an ideal crop. The food values of grains indicate higher protein (15-18%), lipid (6-8%), carbohydrate (62-69%) content. Caloric content is between 370-425 kcal per 100g and is the highest for earthern cultivar. In addition to the presence of all the essential amino acids, the lysine and leucine contents are much higher in chenopod grains than in many of our principal cereals like wheat, maize, rice, barley, finger millet and Italian millet in their content of protein, lipid and minerals. Of paramount significance is the absence of saponins (Partap and Kapoor, 1984).

Average yield per chenopod plant in farmer's field is between 10-80 g. Under these conditions, the grain production is 3.2 quintals/ha and varies with soil fertility from 4.3.31 q/ha.

The holistic report on ethnobotanical, socioeconomic, botanical, agronomical and physiological aspects of this pseudocereal reveals that this crop is important to the people of north Indian hilly region. There is need to undertake large scale germ plasm collection of this slowly vanishing food plant species throughout the Himalayan range for use in future breeding to improve the quality and yield of this crop. Once this is achieved cultivation and consumption be further encouraged among the poor rural hilly people to supplement their nutritionally deficient diet. Food craft studies need to be made to popularise the eatables prepared from the grain chenopods suiting to the food habits of urbanites and generating better economic returns to the growers of this crop.

Urgent studies of above kind should be undertaken to study the biological diversity because of its pressing relevance to genetic resources for mankind. Regrettably, due to lack of ecological planning the biological diverity is being reduced at an alarming rate. At least one species is being lost each day, and by year 2000, 10 million may be lost. Many surviving species may well lose 90% of their population without being threatened to extinction but in this course, they may well have lost half of their source of genetic variability. With the support of the scientific community having sound ecological awareness and political leaders, an expanded effort is required to safeguard those plant resources which are lesser known neglected or under-exploited and have great role in human welfare. The conservation of such plants needs urgent attention which have potential use but are not yet given attention by agriculturists or foresters yet have production value of food, fibre, oil and pharmaceuticals. Various International organizations and institutions already collect and use the genetic variability of the major food crops of this planet. Several national institutes also collect and use the genetic variability of major plantation crops. However, we need now attention of similar intensity for the conservation and utilization of underexploited plant resources.

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WATER POLLUTION IN SANDUR AREA, BELLARY (KARNATAKA)

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INTRODUCTION

The area under investigation is around Sandur and Hospet taluks and belongs to Sandur schist Belt. The schist belt is named after the town Sandur (72° 16' to 76° 42' E Long., 14° 58' to 15° 15' N Lat.). The occurrence of ferrous minerals in the area has brought importance to the mining industry. The exploration and exploitation of these minerals i.e., Iron and Managanese is going on for last 70 years. The extraction of minerals from the area around Sandur and Hospet taluks has led to the deforestation of the schist belt and in turn it has caused ecological imbalance and pollution of nature. The ferrous minerals are located in the ranges like Devadari hills. Kumaraswami hills. Kammadheravu hills. Kanavehalli hills. Ramdrug hills. Donimalai hills and Timmappanagudi hills.

The hills are canoe shaped and divided into northern and southern halves by west to east flowing perennial river Narihalla for which an earthen dam has been constructed near Taranagar. An attempt has been made to detect water pollution in the region by collecting about 50 samples throughout the schist belt. The occurrence of groundwater is mainly noticed in Epidiorritic formations. iron formations and granitic formations.

HYDROCHEMISTRY

The area under investigation dominantly consists of two lithological units viz. Epidiorities and Iron formations. The occurrence of groundwater in iron formation is in the form of natural springs. whereas in Epidiorites it is in the form of open wells. Water samples were analysed to determine the concentration of cations and anions by employing EDTA. It is observed that the water samples from Bheemateerth and Ramghad are acidic and the remaining samples are alkaline in nature. The waters occurring in iron formation are rich in Ca. while those in Epidiorites are rich in Na and K content. The concentration of Mg is homogeneous in both the formations and rich in HCO_3 content. The concentration of Al+Fe throughout the Schist belt is high. Higher concentration of Fe indicates that water inthe schist belt is polluted.

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The pollution may be attributed to the liberation during mining operation of ore fines which are carried away by the rain water and later, they join the main stream by nalas of the reegion. In the course of its transportation some of the material gets dissolved on account of high acidity of the water that has caused the river pollution and as well as the entire groundwater of the region. From the analysis it is observed that the Fe content varies from 0.80% to 8.80%. The permissible limit for drinking water standards according to WHO (1963) and Todd (1969) varies from 1% to 0.3% respectively. In order to detect water pollution in the area the application of Infrared absorption spectra, perhaps for the first time has been successfully employed. The chemical composition of 15 water samples is given in Table 1.

METHODS

Frequencies at which a material absorbs infrared energy depend on the internal vibrations of the molecule and hence upon its composition. Infrared analysis involve the use of radiations of much longer wavelength than that of the visible light. The wavelength range of the spectrum classified as infrared is from 0.75 to 30 microns. But, the important regions for studying minerals and crystals are in the region of 2 to 25 microns. To a mineralogist the infrared spectroscope is an effective tool for the identification of minerals and mineral aggregates. In a mineral, the molecules of different atoms are ground differently. Hence, different groups give different characteristic absorption bands. For example, the hydroxyl group absorbs radiation of frequency at about 3500, 880 and 730 per cm.

The source of infrared radiation may be either a glowing filament or a hot silicon carbide rod both of which emit radiations over a wide range of frequency. The infrared beam passes through a collimator to the specimen which should be in the form of a thin film. The transmitted rays then pass through a system of mirrors on a rock salt prism which can be rotated so as to vary the frequency of radiation received on the detector. The magnitude of the spectra over the wave length is measure on a thermopile or a bolometer, and is recorded continuously on potentiometer.

The polluted water samples under investigation are studied using a Perkin Elmer model 599 I.R. Spectro Photometer in mull media. The mineral is finely agated and a small quantity of the same is mixed with pure paraffin oil, thus forming a suspension of minute crystallites in a viscous medium. The resultant paste is then smeared over an alkali halide plate (of either NaCl or KBr) and a second halide plate is kept on the first one and squeezed to get a thin film of the compound in the oil. This is kept in the spectrometer and the radiation is passed. The resultant absorption spectrum is measured and the minerals are identi-

able 1. Chemical analyses of groundwaters of Sandur Schist belt
All values are in mg/l.

	Sample Number*														
Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Silica	12	16	3.5	8	8	96	40	40	81	4	6	44	4	52	40
Al+Fe	3.2	2.4	1.2	3.2	0.8	2.5	0.8	0.8	2.4	1.6	1.6	8.8	tr	5.6	0.8
Calcium	139	721	122	256	143	55	245	256	96	176	256	689	140	497	77
Magnesium	14	6	19	45	30	65	31	29	88	56	12	11	29	204	47
Sodium	420	630	210	55	210	210	65	50	100	30	50	210	90	100	50
Potassium	130	250	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr
Bicarbonate	400	3600	400	400	600	620	100	800	600	800	600	2000	600	2400	200
Carbonate	tr	tr	160	24	tr	tr	80	tr	tr	tr	tr	tr	tr	tr	tr
Chlorides	779	368	113	297	297	141	595	71	198	57	99	340	127	127	127
Sulphate	14	14	12	12	60	16	17	136	61	74	240	40	36	80	91
Tot. diss. solids	184	272	40	30	920	580	372	520	212	440	80	240	80	824	380
pH	7.8	7.8	7.1	8.6	8.1	7.8	7.6	8.1	8.6	7.1	6.5	7.2	6.3	6.6	8.0
Sp. Conduct. (µmho/cm)	2400	1550	800	960	1200	900	1850	70	100	150	170	720	250	450	--
Kelly s Index	0.95	0.98	0.84	0.33	0.66	0.64	0.52	0.33	0.36	0.22	0.73	0.9	0.66	0.19	0.36

*Samples 1-7 from Epidioritic formations: 1. Sandur, 2. Taranagar, 3. Nandihalli, 4. Kanmerayangudi, 5. Narsapur, 6. Hoshalli, 7. Navalatti; Samples 8-15 from iron formations: 8. Harishankar, 9. Jogikolla, 10. Bairatheertha, 11. Bhimatheertha, 12. Jambinath, 13. Ramghad, 14. Devagiri, and 15. Kumaraswami fied by comparing the values with those given in standard charts.

About 250 ml of water sample was taken in a 500 ml beaker and evaporated to dryness. The residue (total dissolved solids) was scrapped out and subjected to infrared absorption studies in the region of 4000 to 200 cm-1 by employing Nujolmull technique.

RESULTS AND DISCUSSION

The infrared absorption of the total dissolved solids indicate that the mineral Haematite is coordinated with water. The stretching vibration frequencies around 3700, 3600 & 3400 are assigned for the OH molecule or to the water molecule phase. A strong and broad absorption around 1630, 1020, 1010, 520 and 460 per cm, indicates the presence of the polluted mineral Haematite inthe water smaples. The infrared frequencies of water samples are given in the Table 2.

The following conclusions emerge from the study:

a. The concentration of Al + Fe is high in almost all samples.

b. The water occurring in the iron formations are rich in Ca, where as the water samples occurring in the Epidiortic formations are dominated by Na and K.

c. Fe concentration varies from 0.80% to 8.80% which is harmful for drinking purposes.

d. The infra-red absorption spectra reveal the coordination of Fe with water and hence the water of Narihalla river and the groundwater of the region in most places are polluted.

e. The presence of polluted mineral in water samples is identified as Haematite from the infrared absorption frequencies around 1630, 1020, 1010, 520 and 460 per cm.

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CHANGES IN VEGETATIVE COVER IN THE INDRAVATI BASIN

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Map is an useful aid in studying the environmental issues. It portrays not only the spatial variation of the element under study but also the background information necessary for understanding its association with the other features of the environment. Map is no longer a static representation of a phenomenon. Thanks to the recent developments in map making, it is now possible to construct, quickly and at less cost, a series of maps to study the dynamics of environmental elements.

One of the most important element of the environment is the vegetative cover of land. The rapid increase in population in recent times and the resultant expansion of arable land has greatly reduced the area under forest cover. The processes of deforestation are more active in the new settlement regions. One such region in India is the Indravati river basin. Maps of vegetation ocover of this basin available from various sources at different points of time are compared by method of superimposition. The resultant map portrays the present level of expansion of arable land and the reduced area under forest cover as in 1982.

The Indravti River Basin and Developmental Activities Therein

Indravati is a tributary of the river Godavari. It originates in the Kalahandi district of Orissa and flows through the districts of Koraput in Orissa, Bastar in Madhya Pradesh and Gadchirolki in Mahrashtra. The location of the river basin and the administrative units that lie within the basin are shown in Figure 1. The area of the basin is 41,665 sq.km. The length of the river is 530 km from its source upto its confluence with Godavari. Its important tributaries are Bhaskal, the Narangi, the Boardhing, the Kendru, the Kotri, the Nebra and Bhandia on the right and the Nadiraj and the Chintavagu on the left.

The Indravati drains major part of a region, popularly known as Dandakaranya. This region demarcated by several Central and State Government agencies fro the "three fold tasks of area development, resettlement of refugees in agricultural land reclaimed out of the shrub jungle and tribal development" (V.K. Subramanian 1969). In order to achieve these objectives Dandakaranya

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Development Authority was set up in 1958 by the Government of India under the Ministry of Rehabilitation. During the last two and a half decades, due to reclamation of land, construction of railway line and roads, execution of irrigation projects and development of iron ore mines in theBailadila there has been a great reduction in vegetative cover in this basin.

Source Maps

The following maps were analysed and used in this study.

1. The International Vegetation Map - Godavari Plate, prepared by the French Institute, Pondichery and published by ICAR, 1963.
2. Forest Atlas of India, plates 28 and 33, NATMO, 1975.
3. Agricultural Resource Atlas of India, plates 28 and 33, NATMO, 1978.
4. Forest Maps of Orissa, Madhya Pradesh and Maharashtra, ISRO, 1983.
5. Survey of India Topographic sheets 64 D and H, 65 A, B, E, I, J and M. All the atlas maps are on a scale of 1:1000 000 and Survey of India topographic maps are on scales of 1:250 000, 1:253 440 and 1:50 000.

The earliest map, the International Vegetation Map, Godavari Plate was compiled from topographic maps, literatures pertaining to forest types and field work (French Institute 1963). Unfortunately this map does not cover the entire basin. The partial areal coverage and grouping a large area of forest under shifting cultivation makes the map less useful in this present exercise.

The maps in the Forest Atlas of India and Agricultural Resource Atlas of India are identical in respect of forested area and arable lands. The maps are compiled from topographic maps of late sixties and field work. After careful comparison the maps in the Agricultural Resource Atlas in view of their detailed classification of land use, were used in this exercie (Fig. 2).

The most recent maps on the forest cover of this basin has been published by the National Remote Sensing Agency (N.R.S.A. 1983). The maps, on a scale of 1:1,000,000, were prepared through visual interpretation of false colour composite dispositives of satellite imageries on 1: 1,000,000 for the periods 1972-75 and 1980-82. These maps show the following categories of land use.

I. Forest Land : i) Closed forest, ii) Open and degraded forest, iii) Mangrove forest.
II. Non forestland which includes agricultural land, grass land, shrub land, non forest plantation and barren land.
III. Others which include areas under snow, fog, cloud, shadows etc.

The forest map of NRSA for the period 1980-82 was (Fig. 3) superimposed on the landuse map of the Agricultural Resource Atlas. The area, shown as forest land, on boththe maps werefirst

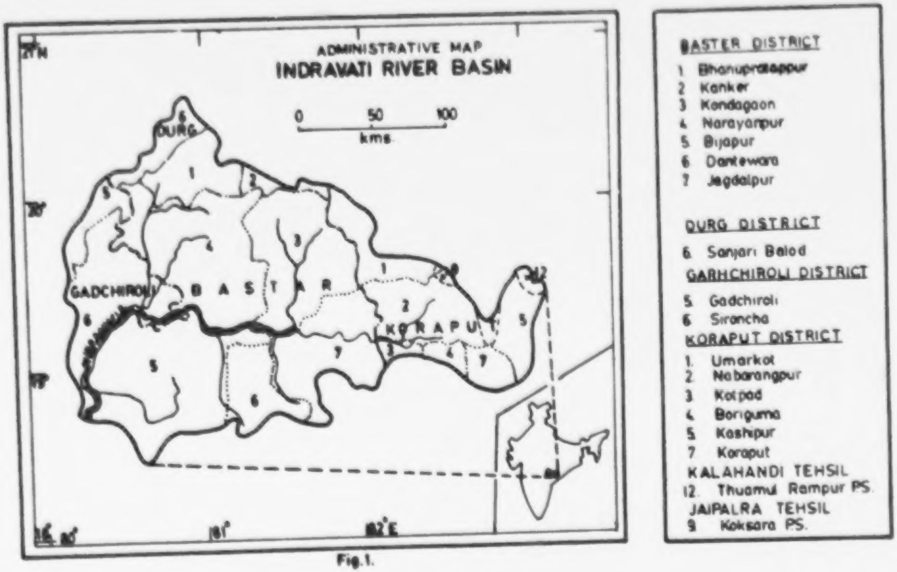
ADMINISTRATIVE MAP
INDRAVATI RIVER BASIN
0 50 100
kms.
DURG
GADCHIROLI
BASTAR
KORAPUT
101°
102°E
BASTER DISTRICT
1 Bhanupratappur
2 Kanker
3 Kondagaon
4 Narayanpur
5 Bijapur
6 Dantewara
7 Jagdalpur
DURG DISTRICT
6 Sanjari Balod
GARHCHIROLI DISTRICT
5 Gadchiroli
6 Sironcha
KORAPUT DISTRICT
1. Umarkot
2 Nabarangpur
3 Kotpad
4 Boriguma
5 Kashipur
7 Koraput
KALAHANDI TEHSIL
12. Thuamul Rampur PS.
JAIPALRA TEHSIL
9 Koksara PS.

Fig.1.

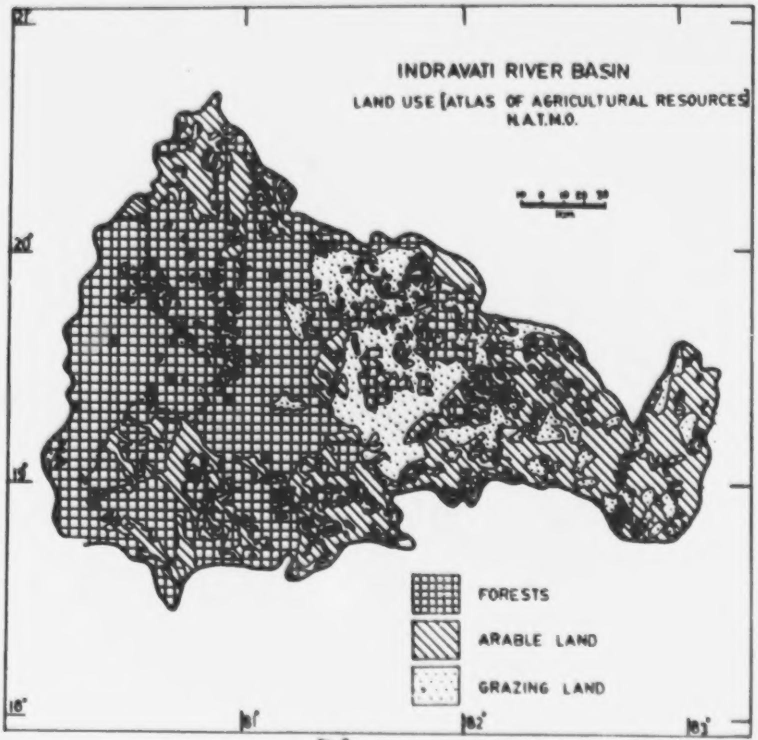
INDRAVATI RIVER BASIN
LAND USE [ATLAS OF AGRICULTURAL RESOURCES]
N.A.T.M.O.
21°
20°
19°
18°
81°
82°
83°
FORESTS
ARABLE LAND
GRAZING LAND

Fig 2

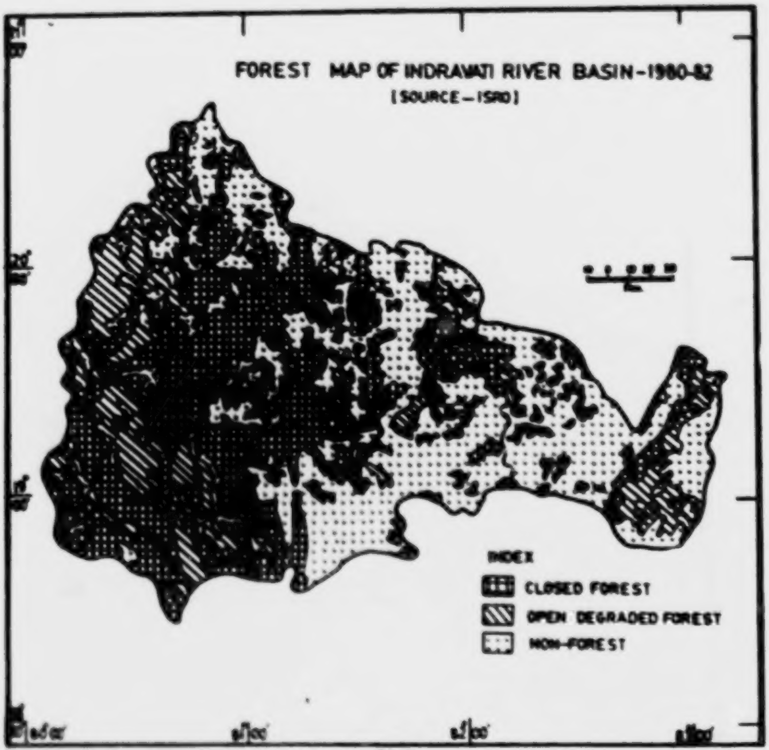
FOREST MAP OF INDRAVATI RIVER BASIN-1980-82
(SOURCE – ISRO)
INDEX
CLOSED FOREST
OPEN DEGRADED FOREST
NON-FOREST

Fig.3.

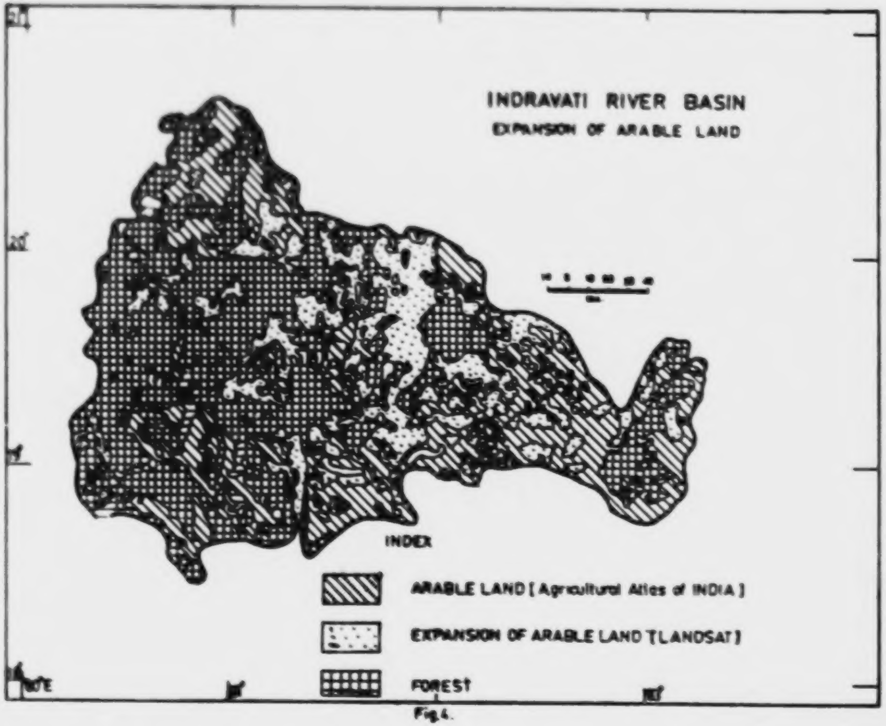
INDRAVATI RIVER BASIN
EXPANSION OF ARABLE LAND
20°
80°E
INDEX
ARABLE LAND [Agricultural Atlas of INDIA]
EXPANSION OF ARABLE LAND [LANDSAT]
FOREST

Fig.4.

demarcated. The lands shown as arable land and barren land as shown on the Agricultural Resource Atlas, were later drawn. It was then noticed that the remaining area is shown differently on these maps; as non forest land on the ISRO forest map and as forest land on the Agricultural Resource Atlas. This area was compared with the latest topographic maps. Wherever cultivated lands are demarcated on the topographic maps, the area was accordingly demarcated as expansion of arable land in the forested areas. Except for a small area in the eastern part of the basin, all areas are under cultivation.

Interpretation

The resultant map (Fig. 4) shows significant expansion of arable land into the forested areas on both sidesof the roads radiating from the town.Kondagoan in Madhya Pradesh. Areas around Dhampur, Chitrakud, Patliguda, Grena and Paitapur have registered expansion of arable areas. Least expansion of arable land has taken place in the Gadchiroli district of Maharashtra.

The approximate distributioin of land under three categories is as follows: Forest 48%, Arable land 30% and Expansion of arable land into forested area 22%. It means that there is a reduction of 30% in forest area within two decades. This figure is only tentative. Thorough checking of the map is needed for the correct estimation of the area under forest. Nevertheless the reduction is very significant.

Field work was conducted around Umarkot, Nowrangpur, Kotpad, and Kondgaon towns. It was noticed athat all most all theopen scrub land in level areas have been brought under cultivation. Only on the low ridges separating the tributary valleys are found the open scrub land. The cultivated lands everywhere extend upto the bank of the river. Where the banks are steep, this practice has led to the formations of deep gullies. There is a need to grow few lines of trees along such banks to stop further accelerated gully erosion.

CONCLUSIONS

Recent development in the techniques of map making, particularly the use of satellite imageries, make possible mapping the dynamics of the environmental elements. The satellite imageries help in monitoring the changes and identifying the areas needing immediate conservation measures. Of course, caution is needed in drawing conclusions from satellite imageries. The accuracy of interpretation of the imageries, to a great extent depends on the personal and specialized knowledge of the interpreter of the area. In its absence grave mistakes may occur. So there is a need to gather ground truth through field survey and from other secondary sources of informations, such as topographic maps, serial photographs and literatures. Exchange of experience between the interpreters and users of the satellite imageries will go in a long way in developing more accurate softwares for interpretation. Accurate interpretation and periodical monitering may bring into limelight, at an early stage itself, the consequences of a bad land use and the needed corrrective measures. This is a new possibility. Can this possibility be used toeducate and motivate people totake up timely action for the preservation of environment? Time only can tell.

ACKNOWLEDGEMENTS

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ENVIRONMENTAL EDUCATION WITH SPECIAL REFERENCE TO POLLUTION

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HISTORICAL STUDY

Environmental Awareness has to precede any attempt at Environmental Education. We will, therefore, try to trace the history of both briefly.

Man evolved in a hostile environment over a million years ago, but managed to survive and develop due to his physiological resistance, adaptability, and intelligence. The experience of victory over an inhospitable world gave him a thirst for domination at the expense of fellow creatures and nature (Tendron 1982). His success is reflected in the evolution of the prehistoric civilizations like the Mayan, Babylonian, Egyptian, Indus Valley, Harappan and Mesopotamian civilizations. The decline of these civilizations was closely associated with ill-judged exploitation of natural resources. Three stages of civilization can be noted· domination by forests, overcoming forests, dominating forests and leading to its own destruction. The action of man is so closely interwoven with that of other environmental factors that, between wrecking of the physical environment and the deterioration of the social and cultural setting, it is impossible to say which is the cause and which the effect (Stockholm 1972, Bachkheti 1981, John 1983). Except as indicated above, primitive man existed in harmony with nature, and the balance between man and nature deteriorated very gradually till about the last two hundred years when the deterioration started accelerating exponentially. Such balance was maintained through totems and taboos, religious beliefs and social customs, born out of thousands of years of experience, and geared to the rhythms of nature, phases of the moon, changes of season, flowering and fruiting of plants, and movements and reproduction of animals, etc. (Dasmann 1976). In India, the Isho-Upanishad has the following profound statement: "This universe is the creation of the Supreme Power meant for the benefit of all His creations. Individual species must therefore learn to enjoy its benefit by forming a part of the system in close relation with other species. Let not any one species encroach upon the others rights (Pal 1981).

With the advent of science and technology, and introduction of formal education, such traditional knowledge of environment and ecology began to be eroded, as the younger generations were

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Data Centre for Natural Resources, World Wildlife Fund-India, 18 Spencer Road, Bangalore 560005, India no longer willing to receive information by word of mouth from their elders (which was the way in which traditional knowledge was preserved in a community). Disposal of sewage and sullage seems to have received early consideration as evidenced by the British Urban Sanitary Act 1388 which prohibited the throwing of any refuse like dung, filth, garbage, etc., into ditches and rivers or other waters, and places within, about, or near any cities, boroughs or towns, and other British Acts of the 1500s (Nair 1984). Rexcavations at Lothal (Gujarat, India) indicate that Harappan Civilization probably frowned upom similar dumping which might block the elaborate drinage system, and that the citizens cooperated. However, the effects of industrial effluents and large scale deforestation appear to have been ignored, probably as a necessary evil of development, or not noticed as the serious environmental and ecological effects took a long time to appear.

The attacks on, and systematic destruction of, the environment roused the anxiety of open-minded and lucid thinkers. The naturalist and writer Alexander von Humboldt was probably one of the first to raise the alarm and demand protection for naturl sites. Other writers like Chateaubri and and Barbey d Auarevilly, and economists like Malthus, began to realise the dangers threatening the future of the human race. In 1853, the Forest of Fontainebleau was declared as a reserve in France, and in 1872, Yellowstone National Park was created in the United States.

But Conferences on the protection of birds held in Paris in 1895, 1902 and 1954 concerned themselves only with birds, and the Conference for the Protection of African Fauna and Florain London in 1933 only with African animals, and did not show much concern about their habitat. Nothing is remembered now of the international conference on nature protection in Berne in 1913, or the congresses in Paris in 1925 and 1931. It was only iin 1947, after World War II that representatives of 24 nations andmany private societies met at Brunnen (Switzerland) to propose the creation of an International Union for Nature Protection, which came into being in 1948 under the patronage of UNESCO, and is now the International Union for Conservation of Nature and Natural Resources (Tendron 1982).

On December 12, 1969, the Council of Europe Committee of Ministers, with the cooperation of the Parliamentary Assembly, recommended setting up a committee of experts for "preserving the Landscape, promoting the establishment of new nature reserves and national parks, and working for the conservation of nature and natural resources and the protection of flora and fauna" (Tendron 1982). The Council of Europe has ever since been doing significant work for the conservation of nature and natural resources.

In India, Town Nuisance Acts existed in the provinces of British India in 1889, and Acts to protect River and Canal waters and some other similar Acts about the same time or litle earlier.

Smoke Nuisances Acts came in 1905, and Agriculturl Pests and Diseses Acts in 1919 while The Shore Nuisance (Bombay and Kolaba) Act was in existence in 1853 itself (Kantha 1974). The Code of Civil Procedure 1908 provides for a declaration or injunction against public not till the 1950s that the need for protecting the environment appears to have received serious worldwide attention. In Britain, the first Clean Air Act, consequent to the death of 4000 persons in 1952 due to 2 continuous days of smoke became law in 1956: this and subsequent Acts had significant effect in reducing air pollution (Ashby 1971).

The Club of Rome whose views were published in its " Limits to Growth (1972). said that development of the sort manifested in the developed societies, and the accompanying life style, were not sustainable in the long run. The Founex Report (1971) made a distinction bewtween the environmental problems faced by the developed countries (industrial pollution, depletion of scarce resources) and those faced by the poor countries (clean water, food, housing, sanitation, employment, etc.). Poverty was seen as a form of pollution. The definition of environment was extended to include the socio-economic setting in which man lives and works in addition to its physical aspects (Dasgupta 1978). It was in this setting that the United Nations Conference on Human Environment was called at Stockholm in June 1972, which drew global attention to the fact that industrial growth producing materioal wealth and power also produced widespread destruction of earth s natural resources and new risks to human health and wellbeing (Strong 1983). The subsequent workshop on Environmental Education (EE) at Belgrade in 1975, and the inter-governmental conference on EE at Tbilisi, USSR, also put forward specific recommendations for conducting EE programme ranging from elementary to post-graduate stage of education in formal as well as nonformal sectors (Anon. 1984). The Stockholm conference resulted in the formation of the United Natiuons Environment Programme. In 1975, UNESCO with the cooperation of UNEP launched the International Environmental Education Programme (IEEP). This has now completed its first three phases of promoting and stimulating environmental education among UNESCO member states: helping the states in their efforts to incorporate Environmental Education into formal educational levels, and non-formal education for the public in general, in a way which favours the preservation and improvement of environment: priority for training of personnel, innovation in educational methods and teaching material, and the education of young people and adults in rural areas, and programmes for put out by the mass media. It is now in its fourth phase covering the biennium 1984-85 when, in addition to other key activities of the earlier phases, priority is being given to the establishment of a Department of Environmental Education in Universities, technical and vocational training, and out-of-school education (Connect, VIII:2: III:4: V:4: CII:4).

Events like the mass death of fish in lakes and streams of Sweden and Norway since the 1950s due to acid rain (Cubberly 1983), the death of 43 people between 1953 and 1956 and permanent damage to the nervous system of 70 others at Minamata (Japan) due to methyl mercury poisoning through consumption of contaminted fish (Kendall 1984), etc. drew global attention to the need for control of industrial pollution. Such controls were generally resisted by industry, as they invariably increased the cost of production, and thereby decreased their profit. When controls were imposed, they were generally for immediate local benefit, and merel tended to either postpone the effect of pollution, or transfer it to some other place. The adoption of tall smokestacks to prevent the local effects of gaseous emissions in Germany and other European countries resulted in the transport of these emissions by the prevailing winds to the Scandinavian countries, causing the mass deaths of fish noted above. Other instances are the sea dumping of chemical and nuclear wastes, and even land fills used for dumping urban garbage, drinage of urban sewage into rivers or lakes, etc. Industrialists bent on profit at any cost even export their polluting manufacturing processes to less developed countries where controls on emissions re less strict. Pollutant residues get concentrated progressively along the food chain, and finally reach man frequently at dangerous levels. In America, DDT at a higher level than would have been tolerated in formula milk was discovered in human milk (Kendall 1984).

A number of international conventions and agreements have been signed with a view to protect the enironment and wild life which are exposed to violation by more than one country. Some of the important ones are listed below:

- Convention oof Wetlands of Inernational Importance especially as Waterfowl Habitats (Ramsar), 1971
- Convention for the Protecton of the World Cultural and Natural Heritage 1972.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington), 1973
- Convention on the Conservation of Migrtory Species of Wild Animals (Bonn), 1979
- Wildlife Convention (Berne), 1979
- Birds Directive (Brussels) 1981
- UN Conference on Law of the Sea, I, II, III.

When the western countries realised that there had to be a limit to the exploitation of natural resources, they not only introduced some amount of control in their own countries, they also tried to introduce such controls in their colonies or developing countries where they had influence. Such efforts were initially resented by the developing countries as intended to prevent them from developing, as seen from the African objection of the Stockhholm Conference 1972 (Mathias 1984). Prime Minister Indira Gandhi also raised a qualified objection there in the following words: "We do not want to put the clock back or resign ourselves to a simplistic natural state. We want new directions in wider use of knowledge and tools with which science has equipped us. And this cannot be one upsurge but a continuous search into the cause and effect and an unending effort to match technology with higher levels of thinking......Modern man must re-establish an unbroken link in the developing countries, however, was gradually oercome. When the Nigerian Delegate to the IUCN Technical talks in Zaire in 1976 raised similar objections, Paul Leyhausen (1976) said "It is often argued that specially the poor countries could not afford to leave wilderness alone. Infact even less than the so called rich countries, can they afford to destroy it. For can the world at large, the human community, afford to let them do it. Wilderness areas are the economically soundest investment any coummunity can make". Indira Gandhi herself said later (1981) that no country can afford the long term cost of ignoring the environment or ecology. This sentiment has been repeated by Rajiv Gandhi, present Prime Minister of India, in his speech to the nation on 5 January 1985 when he said that pollution of the Ganga would be controlled and wastelands replanted to produce fuelwood and fodder. Most developing countries are now aware that environmental protection is a prerequisite for sustained development (Hetzel 1982). There can be no development on a sustainable basis if the environment is not protected for the use of the people (Bliss-Guest 1982).

PRESENT SITUATION

Legislation

What has this awareness of the need for protecting the environment done in India? We have already seen some of the early legislation that existed. In 1977-78, the 42nd Amendment to the Constitution of India was passed, which introduced the following articles in Part IV, Directive Principles of State Policy:

Protection and improvement of environment and safeguarding of forests and wild life: The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country

Fundamental Duties-- It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures, The following Acts have provision for safeguarding the environment:

The Factories Act, 1948
The Atomic Energy Act, 1962
The Insecticides Act, 1968
The Wildlife (Protection) Act, 1972
The Water (Prevention and Control of Pollution) Act, 1974
The Territorial Waters, Continental Shelf, Exclusive Economic Zone, and other Martime Zones Act, 1976 give the Union Government "exclusive jurisdiction to protect the Marine Environment and to prevent and control marine pollution".
The Air (Prevention and Control of Pollution) Act, 1981
Various Police Acts (prescribe limits to noise levels).

Case Studies

The effects of pollution on the environment are diverse and widespread. The focal theme of the 68th Session of the Indian Science Congress Association at Varanasi in 1981 was "impact of the Development of Science and Technology on the Environment". Prof. A.K. Sharma, in his presidential address touched on the different kinds of natural and synthetic pollutants, chemical and radiation pollution, and marine, freshwater air, and noise pollution, and the problems they create, ranging from effects on vegetation to cancer in humans and genetic and mutagenic effects. The focal theme of the 73rd session to be held in January 1986 is "Environmental Management", from which the importance attached to Environment can be seen.

Let us see some case studies of pollution in India. Indian Aluminium Company (INDALCO° in Belgaum constructed an effluent tank next to the factory instead of 1.5 km away. In 14 years, the bunds of the tank breached 3 times, rendering neighbouring fields wastelands by burning the topsoil with effluents of pH 10.5. 1000 acres of paddy and sugarcane fields were affected in 1979. Effluents poured into an irrigation reservoir, then in to Krishna River, killing Fish. They contaminated wells supplying drinking wter, compensation of Rs 13.26 lakhs was sought, but the company offered only Rs. 1.06 lakhs, which was refused by the villagers. Another tank was constructed by INDALCO, which can contaminate the irrigation reservoir through seepage only, even without breaching. The effluents cause air pollution also, leading to lung diseases (Sharma 1980).

The Zuari Agrochemicals factory in Goa is located on a plateau which was under a reserve forest, reportedly harbouring much wildlife including tigers. Today this plateau stands barren even though the factory is confined to only a small part of this area. Obviously a much larger tract than necessary was deforested in the process of establishment of the factorz, and the exposed lateritic rock is now incapable of supporting any plant growth (Gadgil and Malhotra 1980). In 1977, they were forced by court injunction to suspend operations till arrangements to stop pollution of the off-shore sea area were satisfactorily completed (Mathias 1984). Due to adminstrtive and technical legal problems, the case dragged on for years, during which period they continued to discharge polluting effluents (Singh 1984).

Rise in the level of subsoil water in some parts of Andhra Pradesh due to large dams has resulted, through a series of interactions between soil, trace metals and plants, in skeletal fluorosis of local inhabitants, causing knock-knees and serious emotional disturbances and social stress (Agarwal et al. 1982). The same disease has been observed in Karnataka also, caused by change in micro-ecology of the area (Handigodu, Shimoga Dt.) probably due to pesticides (Chengappa 1083).

The industrial towns of Agra, Mathura, Kanpur, Lucknow and Allahabad are situated along the banks of major rivers of the Indo-Gangetic Plains, where industrialisation and urbanisation had been very rapid in the last two decades. The natural slope of the Ganga, Jamuna and Gomti ofthe Ganga system have been mainly used for flushing out the domestic and industrial effluents, as no other geomorphic alternative for flushing them out was available. Congestion, garbage pollution, traffic strangulation, noise and inadequate housing, build up the problems. There is a relationship between the increasing level of air, water, and noise pollution, and the rapid rate of industrialisation (Nagar et al. 1981)

The recent tragedy at the Union Carbide pesticide plant at Bhopal (India) is still fresh in our minds and does not need repetition but a couple of points can perhaps be emphasized.

a) According to a Reuter news report (The Hindu, 8 Dec. 1984) from Danbury (Connecticut, USA), a computerised early warning system which had been installed at a sister plant of the company in West Virginia, had not been installed in Bhopal. This system could have detected the pressure buildup which led to the leak of poisonous gas.

b) It is reported that Union Carbide turned to Bhopal for establishment of this factory after efforts to establish it in Canada had been turned down as it involved lethal gases, and that its factory in West Virginia had been called the smokiest factory in the world (Singh 1985), also that the company stonewalled efforts to put in controls in several of their plants and refused to attend government conferences discussing how to clean the atmosphere (Sharma 1985).

Chemicals and pesticides which have been banned as dangerous in developed countries, continue to be manufctured in developing countries (Vasu 1984). According to one estimate, as many as two million people are affected by pesticide poisoning throughout the world, of which 40,000 die: 30,000 of these deaths (75%) are in the developing countries (Devasia and Balakrishnan 1984).

There is no limit to the number of instances which can be quoted. But what is the remedy?

Remedial Measures

Both the Water Act 1974 and the Air Act 1981 provide for central and State Boards for Prevention and Control of Water/Air Pollution, with limited membership from among the public. The functions of the Central Board are more of advisory, co-ordinating, and assistance giving nature. The State Boards, in addition to these, are to take adequate steps to control pollution, by fixing standards for industrial discharges and giving consent, subject to conditions, for discharges. Anybody violating the standards or conditions can be prosecuted, but no action can be taken unless conviction is obtained in a court of law. The Boards are merely prosecuting agencies, and not enforcing agencies. Further, the membership of the Boards is heavily weighted with government officials and representativs of government companies, and the government is also empowered to give directions to the Board. This restricts effective participation of the public members (Chandrasekharan 1984). Frequently, it is not possible to obtain a conviction as it is difficult to establish a link between cause and effect of pollution, and in any case, the penalties are not sufficiently deterrent.

An environmental impact statement is necssary before a major project is sanctioned, and recently, government announced the extention of this requirement to medium scale industries also (The Hindu, 3 Dec. 1984). However, the procedure adopted in India suffers from several defects. Members of the public are the victims of pollution, but the scheme does not envisage public participation. Unlike the British law which requires publiction of the application for consent, there is no such requirement under Indian Law. The procedure in the United States under the National Environmental Policy Act 1969 (known as NEPA) and rules and orders under it require a public hearing (dramatically illustrated in Arthur Hailey s popular novel "Overload", although with a cynical bent) before a decision is made, and this has been followed by several other countries, but not in India. The Stte Boards in India do not have to consult the public before prescribing conditions for effluents, or declaring control zones under the Water anmd Air Acts (Leelakrishnan 1984). The American method should be adopted and public participation increased.

The costs of environmental damage fall on people different from those who benefit from the development. Oil spills, industrial catastrophes, and floods are examples. Various other human activities also affect renewable resources. In all these cases, the costing of damages is incomplete, as the full extent of damages is not known. Pollution damage as assessed from available data in developed countries is 3.5% of GNP, whereas expenditure on pollution control will not exceed 1% to 2% of GNP. The cost of pollution control is more than compensated by the benefits, and also encourages research into alternative technologies which cause less pollution (Kshirsagar 1983). The principle "Polluter Pays" should be implemented, but frequently the industies which cause pollution are so economically and politically powerful that they are able to thwart efforts to control them. 10-40% of advertising revenues for US magazines comes from tobacco advertisements and therefore freelance medical writers keep off the subject of environmental and health effects of tobacco smoking. When a major American company supplying processing material to tobacco companies released a booklet on environmental causes of cancer, drawing attention on cigarettes as the cause of many different malignancies, a cigarette company threatened to look elesewhere for its supplies: since 1964, there has been no major story on health effects of cigarettes in most US popular publications. In Sept. 1976, British viewers saw a powerful anti-smoking film "Death in the West", featuring, among other things interviews with 6 real cowboys who have lung cancer and emphysema caused by smoking according to their physicians. The producer was sued in British courts, and a court order obtained preventing the film from being shown or even discussed by film makers, and requiring that all copies of the film be destroyed or confiscated. When the Journal of the American Medical Association wanted to write a story in 1982 on this film, and the tobacco companies efforts to suppress it, it was advised to drop it as it might render the American Medical Association vulnerable to legal action (Anon. 1984). Obviously, stricter legislation and enforcement are necessary.

Our environmental laws, which operate on a deterrent theory of criminal justice, are ineffective as the economic benefits of non-compliance are much more than the penalties. To ensure equity among the people sharing the environment, the offences coming under environmental laws should be redefined as liabilities in tort instead of criminal liability. This will enable the penalty to be directly linked to the harm done. To make the compensation equitable, the degree of harm done could be equated to the exact monetary gain made by the defaulting party onaccount of the absence of the machinery required for preventing pollution in the environment. Where necessry, these compensations could be paid to the tribal, rural, or urban people who are the actual losers. The Bords and the Dept. of Environment should be given the legal right to make the assessment and levy it as a tax insted of having to prosecute uSingh 1984).

ENVIRONMENTAL EDUCATION

Both the adoption of legislation to prevent pollution, and more so their enforcement, require public involvement and cooperation. This presupposes an enlightened public, aware of the consequences of pollution, and willing to make its views known. It also requires enlightened politicians and administrtors willing to pass the necessary laws and enforce them. For all this, it is essential that environmental education should be imparted at various stages from childhood onwards, to ensure that planners, administrators, engineers etc., take sufficient precautions to forestall pollution before taking decisions for industrialisation and development, such eduction has to be interdisciplinry in approach, and imparted to all, irrespective of the dicipline of their own speciality. In this context, the work under the IEEP is very significant. In India, the National Committee on Environmental Planning and Coordination (now National Committee on Environmental Planning) and the Departments of Environment, and of Science & Technology, have laid such emphasis on inter-disciplinary research, education and training in the area of environmental management. The University Grants Commission is also advocating interdisciplinary approach by different universities. The Planning Commission has also incorporated environmental impacts and ecological management in the case of all kinds of field-based development projects in its VI Plan documents and has urged all State Governments and the Central Government Ministries to adopt ecologically viable development projects in different fields. The Bangalore University is gradually introducing subjects relating to environment, pollution, and conservation in the syllabus for degree colleges from the first year onwards in chemistry, zoology and botany: it is presumed other universities are doing the same. From 1983, the University of Calcutta has introduced an M. Phil. course in Environmental Science: there is also a Ph. D. Degree.

In primary schools, EE comprises local studies of plants, animals and their habitats, with the aim of stimulating the child s inerest in living orgnisms and in earth, air and water. Progressive teachers feel that if imginatively taught, children s interest can embrace simple biology and earth sciences also among other subjects. However there are serious problems in sustaining this interest at secondary school level. Environmentally based studies of primary school are rather abruptly replaced by circumscribed scientific disciplines, some of which are arbitrarily chosen and of narrow and special kind. The options emerging from education deelopment work such as the US Biological Sciences Curriculum, study in Sweden and elsewhere, hve provided opportunities for reform leading to more effective secondry school education on environmental subjects.

On account of significant development in Europe, the United States and the Soviet Union, the recognition that the management of natural resources is an applied science in its own right has resulted in reassessment of the content of courses in biology and earth sciences: ecology and related subjects have been drawn into a debate about the value of broader based studies at undergrduate levels as opposed in early specialisation. Efforts are being made in India also to change the syllabus gradually at undergaduate level to include subjects having more emphasis on environmental resources and conservation (Pritchard 1968).

In India, the *National Committee on* Environmental Planning and Coordination (NCEPC) constituted in 1972 had as its major objective "promoting research in environmental problems and establishing facilities for such research whereever necessary". Funds were allocated in the Fifth and Sixth Five Year Plans for promoting research in environmental subjects, and the Environmental Research Committee (ERC) and the Indian National Man and the Biosphere (MAB) Research Committee were constituted to assist the Department of Science and Technology initially, and later the Department of Environment in fostering and supporting research work. Such environmental research work is now being sponsored by the National Committee on Environmental Planning (NCEP).

From all the above, it is abundantly clear that environmental education at all levels is a primary necessity in order that we may be able to preserve the environment in sufficiently healthy state to support all life, including human life, on earth, as it has been said that whatever happens to beasts soon happens to man (Burton, 1977). By making animals extinct, let us not become extinct ourselves!

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ENVIRONMENTAL POLLUTION CONTROL AND ECOLOGY IN NEYVELI

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Neyveli Lignite Corportion is a Government of India Enterprise in the Department of Coal under the Ministry of Energy. It is located in South Arcot District of Tamil Nadu, 200 km south of Madras. Utilising lignite available in Neyveli area, the following industrial units are in operation:

1. Mine I of 6.5 million tonnes of lignite per annum capacity.
2. A Thermal Power Station-I of 600 MW installed capacity (6x 50 MW + 3x100 MW) using lignite as fuel.
3. A Briquetting and Carbonisation Plant (B&C Plant) of an annual capacity of 327,000 tonnes of carbonised briquettes of lignite named 'Leco' and 109,000 tonnes of charfines.
4. A Process Steam Plant, supplying process steam to Fertilizer and Briquetting and Carbonisation Plants. The process Steam Plant uses as fuel, Lignite and Tar, neutral oil and surplus gas the last three being chemical by-products from the Briquetting & Carbonisation Plant.
5. A Fertilizer plant with an annual production capacity of 152,000 tonnes of urea has been in operation since 1965, using lignite as feedstock. The feedstock was changed over to furnace oil in 1979.
6. A Clay washing plant with an annual capacity of 6000 tonnes washed white clay, using clay occurring in the lignite mine.

The following new projects are under construction:

1. Second Mine Stage-I (4.7 million tonnes per annum)
2. Second Power Station Stage-I of 630 MW (3x210 MW)

The following expansion projects sanctioned in 1983 by the Government of India have been taken up for execution:

1. Second Mine Stage-II (From 4.7 to 10.5 mill. t/yr)
2. Second Power Station Stage-II (from 630 MW to 1470 MW by the addition of 4x210 MW sets.)
3. 400KV transmission lines from Neyveli to Madras and Neyveli to Salem and 230 KV line Neyveli to Pondicherry with switching facilities.

Feasibility Reports for the following new Projects have been submitted recently to the Government of India.

1. Third Mine of capacity 11 million tonnes per annum.
2. Third Thermal Power Station of 1500 MW (3x500 MW) installed capacity, supported by the Third Mine.

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3. First Mine Second Expansion from 6.5 to 10.5 million tonnes per annum.
4. Expansion of First Thermal Station to 720 MW by addition of one unit of 120 MW capacity with lignite supply from the First Mine Second Expansion.
5. High Temperature Carbonisation Plant of an annual capacity of 4 lakh tonnes of hard metallurgical coke with lignite supply from the First Mine Second Expansion.
6. 400 KV transmission system for evacuation of power from the second stage of the Second Power Station.
7. 400 KV transmission system for evacuation of power from the Third Power Station.

DESCRIPTION OF INDUSTRIAL UNITS AND THEIR ENVIRONMENTAL ASPECTS

First Thermal Power Station (600 MW)

This Thermal Power Station (NTPS I) comprises six units of 50 MW each and three units of 100 MW each. Each 50 MW Turbo Generator is fed by a Steam Generator (single drum, natural circulation, dry bottom, pulverised-lignite-fired, two-pass, non-reheat type) producing superheated steam (220 t/hr at 540 °C and 101 kg/cm . Each 100 MW Turbo Generator is fed by two similar boilers of same capacity. The first 50 MW unit was commissioned in 1962 and the last 100 MW unit in 1970. The other units were commissioned in betweeen, in stages.

The Power Station is located at the pithead of Mine-I and gets its lignite requirements from the mine by means of two belt conveyor systems with an intermediate Ground Storage Bunker. Within Thermal Station, storage bunkers of reinforced concrete construction receive the lignite. Internal system of conveyors transports lignite from these bunkers to crushers where lignite is crushed to 20 mm size. From the crushers, lignite goes to the boiler bunkers. Each boiler is equipped with four pulverising mills, each being fed by its own scraper/belt feeder, drawing the crushed lignite from the boiler bunker.

The boiler is fed by pulverised lignite with gross calorific value of about 2800 kcal/kg and average ash and sulphur contents of 7% and 0.5%, respectively.

The main fuel for the boilers is lignite, furnace oil being used only for start-up and flame stablilisation. Each boiler requires about 1500 tons lignite per day.

Fly ash collection is done by mechanical precipitators of about 85% efficiency. The ash as well as bottom slag is hydraulically sluiced to an ash pond 2 km away where the ash settles and clear weater only flows out over a surplusing weir to a nearby nallah. This water has been chemically tested and found harmless.

The exhaust flue gases drawn from the furnace by the Induced Draught Fans escape through the chimney at an exit velocity of 22.8 m/sec at 158 °C. There are four stacks, serving twelve boilers as detailed below:

Stack No.	Height (m)	Boilers
1	60	1, 2, 3
2	60	4, 5, 6
3	60	7A & 7B of 7th Unit
4	120	8A, 8B, 9A & 9B of 8th and 9th units.

A.D.M. plant with a capacity of 90 m per hour of treated water, provides the necessary make-up water for the boiler feed.

Closed cycle circulating water system with Induced Draft Cooling towers is adopted in the station. The outlet water from the condenser at a temperature of 40 °C is cooled in the cooling towers to 30.5 °C. Make-up water for the circulating water system is met from the lake, which stores the water pumped out from the deep aquifers of the First Mine.

Neyveli Second Thermal Power Station (Stages I & II)

The first stage of Second Thermal Power Station consists of three units of 210 MW capacity. Construction of the above is in progress.

The boilers are of single drum, natural ciruculation, dry bottom, single reheat, pulverisd-lignite-fired type, having balanced draft furnace. They are of tower type design to minimise erosion by fly ash. The boiler will be capable of generating 690 t/hr of superheated steam at 158 atm. pressure and 540 °C.

Each boiler will have 6 beaterwheel mills all round the furnace, each will serve one pulverised fuel burner. The boilers are designed for 100% lignite firing, fuel oil being used only during start-up and for flame stabilisation.

To limit enviroinmental pollution to the minimum the dust precipitation and collection system will have Electrostatic Precipitators of 99% efficiency arranged in six electrical fields but five of the fields can give 99% efficiency.

Each boiler is provided with an individual Reinforced cement concrete stack of 170 m height. The exit velocity of the gases at 25 m/sec. and 149 °C will further add to the plume rise and improve the effective stack height before dispersion.

Closed cycle circulating water system with Natural Draft Cooling Towers is adopted in the station. The outlet water from the condensers at 41 °C will be cooled in the cooling towers to 32 °C for reuse in the condensers. The cooling tower is of 116 m height and 90 m base diameter. Make up water for the circulating water system is met from the lake which stores the water, pumped out from the aquifers of the Second Mine.

Water required for the boiler make up is obtained from Demineralised water plant which gets its raw water from a borewell situated close to the D.M. Plant.

Lignite will be received from the mine by a single line of belt conveyors and stored in the open storage yard in the power station. The yard has a storage capacity of 126,000 t with provis on for covered storage of about 20,000t. Two streams of conveyors will feed the boiler bunkers after preliminary crushing.

The requirement of lignite will be about 5000 tons per day per boiler. As the lignite has a moisture content of about 50%, there will be little pollution, owing to lignite dust. However hydrants with sprinkler arrangement will be located around the lignite stockyard to supress the dust. Tall trees will be grown on the periphery of the stockyard to further trap the fugitive dust.

The fly ash as well as the bottom ash will be mixed with water and hydraulically sluiced to an Ash Disposal Pump House whence the ash slurry will be pumped out through pipes to a large ash dumping area 2.5 km away. Ash will be retained in the dump and the clear supernatent water will be surplussed to a nearby nallah.

Four more similar units of 210 MW capacity will be added to the first stage in the same station coumpound as stage-II extension. This project was approved by the Government of India in February 1983 and has been taken up for execution. The equipment for stage-II will be similar to that of Stage-I and the requirements of fuel, cooling water, and Demineralised water and production of fly ash will be proportional to the corresponding stage-I quantitites.

With a view to control ambient pollution further, the individual stack heights of the boilers in Stage-II are proposed to be as high as 220 m as against 170 m obtaining in stage I.

Environmental clearance for Neyveli Second Power Station, Stages I & II has been obtained from the Central and State authorities to whom environmental impact statements as prescribed, have been submitted with details of nature of air and water pollution likely to be caused and the remedial measures, proposed to be taken thereof to safeguard the biosphere.

ENVIRONMENTAL IMPACT OF THERMAL STATIONS AND REMEDIAL STEPS

The main pollutants omitted from the stacks of Thermal Power Stations are particulate matters and Sulphur dioxide, besides oxides of nitrogen and hydrocarbons. The degree of pollution depends on factors such as quality and quantity of fuel used, type of firing, efficiency of operation, amount and type of waste emission, meteorological conditions and topography of power plant area and adjoining habitations. As prolonged exposure to polluted atmosphere is injurious to human as well as plant life and has a corrosive effect on materials, it is necessary to minimise the impact of pollutants.

Particulate Pollution

Lignite has an ash content of about 6 to 7% which is very much lower than the ash content of average Indian coals (upto 40%). For minimising pollution by particulates, the abatement technology chosen for the projects under construction at Neyveli is electrostatic precipitation.

The electrostatic precipitators depend on static electricity and are highly efficient for removal of a wide range of particulates. The efficiency of ash collection is of the order of 99%.

The electrostatic precipitators in Neyveli Second Power Station have six electrical fields, the capacity being such that even with 5 fields, dust collection efficiency of 99% is guaranteed. Thus sufficient margin has been built in for reliable operation.

The fly ash escaping through the stacks of 170/220 m height will be dispersed over a wide area resulting in minimum ambient pollution.

Sulphur Dioxide Pollution

The sulphur content of liginite is about 0.5% to 0.6% oxide of sulphur escape through the chimney causing air pollution. High concentration of SO in the atmosphere could result in increased morbidity and mortality from respiratory diseases in human beings and cause damage to animal/plant life and to materials. Once in the atmosphere, SO would react photochemically or catalytically with other constituents to form sulphur trioxide, sulphuric acid and salts of sulphuric acid.

SO and SO are washed out of the air by rain or settle out as aerosols and are absorbed by soil and plants. But, in local atmospheric inversions, high ambient concentration can build upto hazardous levels and given still air conditions, these can persist for long periods.

The possible strategies available to minimise SO pollution include (a) Dilution to atmosphere by tall stacks, (b) Fuel desulphurisation (c) Flue gas desulpohurisation (d) Power Plant siting away from populated areas.

No commercially viable method is available in the country at present for removing SO from fuel or flue gas. Even in developed countries like USA and France where the extraction plants are in operation, it is gathered that the initial and running costs are very high maintenance is troublesome and frequent failures compel the authorities to shut down the main generating plant, thus reducing the plant availability.

Also indigenous Research and Development efforts are yet to yield results in developing suitable desulphurisation plants which can be installed and operated economically. Hence the abatement strategy adopted in India is provision of tall stacks. Although there is no reduction in the quantity of omission, tall stacks assist in dispersion with consequential reduction of ground level concentration locally in most weather conditions.

Detailed studies have been done by NLC's consultants in respect of design of chimneys vis-a-vis air pollution and as per their recommendations, individual stacks of 170 m height have been adopted for Neyveli Second Power Station Stage-I units, 220 m height stacks are proposed for Stage-II units.

Solid and Liquid Waste Disposal

As already mentioned, fly ash is disposed of through hydraulic sluicing to an ash dump away from the power station. There is also provision for collecting dry ash to cater the demand from the cement manufacturers as the ash is found to have pozzalona properties. Research and Development work has been done on the fly ash by NLC engineers and scientists in collaboration with others for using it as a building materials and the results therefrom have been encouraging. Field studies have proved that partial substitution of ash can save upto 20% of cement by weight in cement concerete without any loss of strength in the latter. Fly ash has been used in low cost housing in Neyveli. The Centre for Applied Research and Development of Neyveli has developed distempers, insulating bricks, light weight aggregate from fly ash. Fly ash mixed with cement has also been used in road-making in Neyveli area. Thus a waste product and pollutant is being converted into a useful one.

After meeting the requirements of the customers like cement manufacturers and internal use in NLC, the balance ash is hydraulically disposed of. In order to ensure that the ash dump does not create nuisance, the dumps will be surrounded by trees, which will be planted all round the embankment. As and when the ash dump gets completely filled up, they will be reclaimed, levelled and suitable trees will be planted.

The main water effluent from the power station is the supernatent water from the ash dump. The quality of water discharged from the ash pond of First Thermal Station has been chemically tested vide Annexure-I and found to be harmless. This clear water is let into the nearby nallah which flows over NLC land.

Fuel Handling Emission

In Thermal Station-I, lignite is stored in closed bunkers. whereas in Thermal Station-II lignite will be stored in open storage yard to facilitate easy handling and flow of lignite. The stock piled lignite will be reclaimed through reclaimers and fed to the boiler bunkers through conveyors, crushers and screens. As the lignite received has about 50% moisture, there will be little flying off of lignite dust. However, dust suppression will be provided by hydrants and portable sprinklers around the area. Further tall trees with dense foliage will be planted on the periphery of the stockpile to trap the fugitive dust.

Noise Pollution

It has been stipulated in the contracts entered into with vendors, supplying equipment for Neyveli Second Power Station Stage-I that all equipment have to be designed/operated to have a noise level below 85 dB. The control room will be provided with sound proof walls and panels. At local operating posts also, control cabins with glass panelling shall be provided for the operators.

Neyveli Mines-I

The lignite bearing area at Nevyveli covers an area of about 480 sq.km and contains a total indicated reserves of about 3300 million tons of lignite, as per investigations so far carried out. The first mine has a selected area of 16 sq.km with a mineable lignite reserve of 240 million tons and is located on the northern part of the lignite bearing area. The average thickness of the lignite seam is 15 m. The thickness of the overburden varies from 50 to 72 m. The annual production from the mine at presentis around 6.5 million tons.

The overburden removal is carried out in four overburden benches. In each bench, there is a Bucket Wheel Excavator, a system of belt conveyors, tripper and spreader.

The overburden stripped by the Bucket Whell Excavator is transported by conveyors and the soil is spread in a controlled pattern on the refilling side of the mine by the spreader.

The lignite is also mined by Bucket Wheel Excavators and conveyed by a series of conveyors to the consuming units through a Ground Storage Bunker of 60,000 tons capacity.

The lignite seam in the mine is sandwiched between clays, sands and cuddalore sandstones above and aquifer sands below. The artesian aquifer is part of Cuddalore sandstone formation. The thick beds of water bearing sands and gravels contain water under pressure.

The confined groundwater in the aquifer sands exerts an upward pressure of 5-8 kg/sq.cm. For successful mining of lignite, depressurisation of the aquifer is essential. This is done by large scale pumping of water to avert heaving of the mine floor from the aquifer. However, such pumping is restricted to the minimum needs to enable mining operation.

For mining one ton of lignite about 15 tons of water is required to be pumped out. Water thus pumped out is stored in an artificial lake and is drawn to meet the industrial and township requirements of Neyveli.

The overburden consists of clay, sand and hard cuddalore sand stones and to win over one ton of lignite about 5 cu.m overburden has to be removed. Systematic drilling and blasting is resorted to by way of forward preparation, to loosen the sandstones so that the Bucket Wheel Excavators can effectively tackle them.

A set of ancillary equipment like blast hole drills dozers, dumpers, shovels, tractors, cranes etc. are used for forward preparation of the strata, levelling and shifting conveyors. The mine has been supplying lignite to downstream industrial units since 1962.

Neyveli-Mine II

The area chosen for the second mine is about 5 km south of the Mine-I and is spread over an area of 26 sq.km with a total lignite reserve of 330 million tons. The annual production capacity targeted is 4.7 million tons of lignite in Stage-I and 10.5 million tons after Stage-II expansion and will support Neyveli Second Power Station of 1470 MW installed capacity.

The thickness of the lignite seam varies from 9 to 20 m and the overburden from 55 to 90 m. As in the case of Mine-I, the lignite seam is sandwiched betweeen clays, sandsand cuddalore sandstones above and aquifer sands beneath.

The method of mining will be similar to that in Mine-I. The lignite mined out willbe stored at the pithead in Ground Storage Bunker of 75,000 tons capacity, provided with stacker and reclaimer arrangement. The lignite will be transported to the Second Thermal Power Station by conveyors.

Large scale pumping of water is resorted to as in the case of Mine-I, to depressurise the aquifer beneath the lignite seam and the water pumped out is stored in a lake formed for the purposes. However such water pumping is restricted to the minimum needs to enable mining operation. The lake will supply the make up water requirements of Second Thermal Power Station.

Conventional mining equipment like dumpers, dozers, shovels, blast hole drills are used for ancillary jobs like preparation of overburden. Drilling and blasting will be carried out to loosen the hard Cuddalore sandstone strata for efficient handling by Bucket Wheel Excavators. About 6 cu.m of overburden has to be removed to win over one ton lignite. Work on the mine has already been started and the mine is being developed.

CAUSE OF AIR POLLUTION AND SAFEGUARDS AGAINST IT IN THE MINES

Open cast mining operations result in destruction of natural vegetation, soil erosion and wash off from the soil dumps and generation of dust.

The stripped soil is dumped outside the mine till sufficient space is created inside for fill back operation. Thus the soil excavated, after dumping, forms big heaps and if they are left unattended over a period of time, heavy soil erosion will occur, owing to winds and monsoon rains. This would lead to filling up of drainage courses. Dust gets air-borne, is carried away and gets deposited in the residential buildings of the township. To mitigate these ill-effects, soil dumps are levelled, adequate drainage courses laid out and side slopes flattened to minimise erosion. If necessary, additional bunds, masonry chutes, check dams etc., will be erected for the same purpose.

Afforestation is a well known method of preventing erosion of the soil dumps. Hence suitable creepers, which will act as soil binders are being grown on the slopes and different species of suitable trees planted on the dump. The overburden is sterile and lacks nutrients and hence, manuring is resorted to rehabilitate the soil. Reclamation of the inside filling area is contemplated by dumping top soil separately over the already dumped area in Mine-II and III.

As master plan for maintaining the ecological balance has been prepared with the assistance of "International Forestry Consultant" and a massive afforestation programme has been launched in the project area. The vegetational barriers will improve the moisture content and stability of the soil, arrest wind-blown dust and reduce noise as well. Based on the recommendations of the consultant, steps have been taken (a) to conserve land degraded by open cast mining by stabilising and revegetating the affected areas, (b) to provide or supplement the existing resources of fuel, fodder, small timber, fruits, vegetables, fish meat etc., to the local people, (c) to provide recreational facilities by way of establishing parks, playgrounds etc., to residents to ensure a better atmosphere and (d) to achieve a rational utilisation of the vast, resources of aquifer water foe power, industry, agriculture, forestry, fisheries etc.

With the implementation of the massive afforestation schemes soil erosion will be reduced. Climate will improve. Small ponds, formed over the dumps, will attract water fowl. When the barren lands are clothed with greenery, the dreary appearance of the soil dumps will be a thing of the past and a new chapter in recreation forestry will be ushered in.

DUST CONTROL

The foration of dust in the mechanised open pit is due to various factors like huge material handling, transport vehicles, blasting and operating of mining equipment. The following methods are adopted to reduce generation and dispersal of dust:

a. Use of sharp teeth for BWE's and their timely replacement when worn out.
b. Use of sharp drill bits for drilling blast holes.
c. Modification of hoppers at the transfer points, and
d. Spraying of water on roads and other dusty areas.

Fleet operators of conventional equipment, who are likely to travel under dusty condition, will be provided with respirators.

In the first mine, studies conduted in collaboration with the Regional Labour Institute, Madras, revealed that the actual dust/lignite concentrations in most places in the mine were found to be less than the threshold limit values.

The workers are subject to regular medical checkups at specified intervals in the Department of Industrial Hygiene and Occupational Diseases of the General Hospital of Neyveli Lignite Corporation. Similar procedures will be continued in respect of the on-going and future projected also.

NOISE CONTROL

Noise, i.e. unwanted sound, causes general feeling of annoyance and irritability, interference with wanted sound, distraction, fatigue and reduction in performance efficiency. Exposure to excessive and prolonged noise may raise blood pressure, cause depression and damage the human ear.

Noise is caused by several mining operations like blasting, operation of BWE's etc. Tractors, dumpers, excavators and the like generate noise, during movement and operation, which cannot be totally avoided. However, measures are taken to ensure that noise level is muffled by the use of silencers. Ear protection devices are provided wherever necessary. Proper greasing and lubrication of machinery is also carried out through preventive maintenance to reduce the intensity of noise produced.

The township is situated away from the mines. Further, tall trees in the township serve to attenuate the noise level. Therefore the township is totally free from direct disturbance from its polluting sources.

Effect of Vibrations

Vibrations are caused due to moving parts of the mining machinery and transport vehicles, Regular checking and proper maintenance is carried out to reduce the vibrations to tolerable limits.

The effect of vibration, emanating from the blasting operations in the mine, on the buildings was studied and blasting techniques were suitably modified to establish safety in this regard.

PUMPING OF MINE WATER AND ITS EFFECT

The quantitative and qualitative modulations in water, due to mining, poses problems to the mine and its environs. Pollution, inundation, subsidence, saline water intrusion in coastal zones, drying of wells and fluctuation of water table are different facets of the problem.

In Neyveli mining area, the ground water exerts an upward thrust of 5 to 8 kg/cm, and before mining lignite, this pressure has to be controlled to avert heaving of the mine floor. The cone of depression caused by pumping operations for ground water control in a semi-confined aquifer is being maintained with care so that no harm is done to the water potential and the Neyveli environs. By proper ground water budgeting, the water balance is maintained in tact.

FERTILIZER PLANT

The Fertilizer Plant has been in operation from 1965 to 1979 using lignite as feed stock. The feed stock has been switched over to furnace oil since 1979. The designed capacity of the plant is 152,000 tons urea per annum. Specific consumption of furnace oil is about 0.6 kl per ton urea. Furnace oil has a gropss calorific value of 9896 kcal/kg and has a sulphur content of 4% maximum being 4.5%. Its carbon content is about 82%. Of late LGHS is also used as an alternative fuel in the place of furnace oil. Gross calorific value of LSHS is 10,280 kcal/kg. and its carbon and sulphur contents are about 876 and 1.75%, respectively.

The factory is divided into five main sections viz. (1) Gas Generation, (2) Gas purification, (3) Air and Gas fractions, (4) Ammonia and (5) Urea.

By partial oxidation of the fuel oil using steam and oxygen, a gas containing mainly CO and hydrogen is produced. The gas mixture is purified, and CO is converted to CO . The gases CO and hydrogen are separated and the pure CO is sent to urea section. Hydrogen is sent to Gas fraction section to mix with Nitrogen which is obtained from air fractionation in the ratio 8:1 and is sent to ammonia section where it is pressurised and converted to ammonia in Monticatine converter. The oxygen obtained in air fractionation is used for oil gasification. The liquid ammonia and carbon dioxide are combined to form urea. The urea melt is sprayed fromthe top of the prilling tower to form urea prills.

Solid Wastes

Carbon pellets are obtained as solid waste product in the oil gasification plant and they are stored separately in the open yard for disposal to prospective buyers.

Ash from process steam boilers are disposed in the form of slurry using waste water.

Gaseous Pollutants Dispersed Through Stacks

(i) There is a chimney in Gas Purification Plant having a height of 30 m emitting flue gases containing SO obtained by incineration of H S off gases which is within the limits prescribed by pollution control board.

(ii) There is a stack with a height of 30m in the Air and gas fractionation plant used as flare stack for burning tail gas to CO .

(iii) A flare stack with a height of about 40m is in the gasification section to flare and burn occasionally the raw gas at times of emergencies and during startup for a short period.

Liquid Waste

Main liquid effluent is the cooling water blow down from various sections. They are let out into the drains and the combined effluents of the entire factory is discharged into the inland surface water system going through the landed properties of N.L.C.

Occasional liquid effluents from Urea Plant containing ammonium carbonate are led into a protected lagoon from where they are allowed to evaporate. The effluent condensate from HCN stripper overhead condenser and the effluent as carbon slurry from slurry separator of the oil gasification section contains cyanide as impurity. The HCN bearing effluent from this section goes to effluent treatment plant where the concentration of cyanide in the effluent is completely removed by chlorination using bleaching powder.

The effluent after being treated with bleaching powder is allowed to pass through settling tanks inside the Fertilizer factory and let into the drain.

BRIQUETTING AND CARBONISATION PLANT

In this plant raw lignite from the mines is crushed, dried, compressed and carbonised for manufacturing lignite coke called Leco which finds extensive applications both as an industrial fuel and as chemical reductant. As an industrial fuel this is used in industries such as cement, paper, tea, textiles, fried gram, refractory, bricks and tiles, tyre retreading, match and sago industries. Leco substitutes for hard coke derived from coal procured mainly from upcountry and is superior for use as a chemical reductant on account of its low ash and low sulphur content, phosphorous being almost nil. As a good reductant, it finds wide applications in several industries such as Calcium

Carbide, Ferroalloys, Mini-steel industries, foundries, pig iron and Titanium industries. Some of the industries have switched over from furnace oil to Leco thereby contributing to substantial saving in foreign exchange. Leco is also used as a domestic fuel and as such helps to save thousands of trees from felling.

In the process of briquetting and carbonising, several useful byproducts like carbolic acid, multivalent phenol, ortho Cresol, metapara-cresol, xylenol, tar and neutral oil are obtained. These byproducts are used in many industries such as pharmaceuticals, resins, disinfectants etc.

The major sections in the plant are (i) Briquetting Plant, (ii) Carbonisation Plant, (III) Char Handling Plant, and (iv) Tar Products Unit.

The raw lignite from the mine with a moisture content of 52 to 56% is crushed to a size of 0.8 mm. The crushed lignite is dried in tubular driers. The dried lignite with 9-11% moisture content is then compressed in quadruple extrusion processes which are 13 in number. In the low temperature carbonisation plant the raw briquettes are converted into a char product which is lumpy and resistant to shatter and abrasion, by carefully heating it in the absence of air and removing volatile matter. The capacity of the plant is 327,000 tonnes of LECO and 109,000 tonnes of char-fines per annum. The gross calorific value of LECO is 6700 to 7100 kcal/kg which makes it an excellent fuel.

In the process of briquetting and carbonisation several useful byproducts like carbolic acid, multivalent phenol, ortho-cresol, metaparacresol, xy!ol, tar and neutral oil are obtained.

No fuel is used directly in this plant. While carbonising the raw briquettes which is made out of lignite (raw material for the process), gas evolved in carboniser plant is used as heating medium.

Raw water for the plant is obtained from the lake which is filled by groundwater pumped out from mines.

Solid Wastes

The fine dry lignite dust in the conveyors/stamp pits is extracted by the deducting blowers where it is sludged with water in order to minimise the dust pollution in the atmosphere. The sludge from the blowers is led to sludge pits through pipe line and open channel. The sludge is allowed to settle in the pits. The lignite dust that has settled in the pits is removed manually and stacked outside for sales as "Lignite dust".

Liquid Wastes

The liquid effluent coming from various sections contains traces of nitrates, chlorides, sulphates etc. Total dissolved solids in the effluent are kept within limits. The toxic substances are removed in the Biological Treatment Plant and the effluent is discharged into inland surface water stream going through the landed properties of NLC.

Stack and Fuel Handling Emissions

All the dust, except microfines, are recycled using dedusting system consisting of Blowers, Wet Cyclones, Electrostatic precipitators.

There are stacks for Electrostatic filters emitting very fine dust in insignificant quantity that cannot be recovered. The major portion of the dust is recycled to the process. There are chimneys for dedusting blowers emitting very fine dust of very insignificant quantity that cannot be recovered.

Surplus carboniser gas is utilised as fuel in process steam plant and middle oil distillation plant. At times of emergency carboniser gas is burnt in the flat stack.

Process Steam Plant

The Process Steam Plant caters to the steam requirements of Fertilizer Plant and Briquetting and Carbonisation Plant, which require steam at different parameters. The steam is generated at a higher pressure than the requirement of the chemical plants and passed through back pressure turbines to incidentally generate power for meeting partially the power requirements of chemical plants in addition to meeting its own auxiliary power requirements fully.

The plant has three steam generators of 160 t/hr capacity. The boilers are designed to burn lignite from the Mine as the main fuel. In addition, the boilers are provided with burners to burn fuel oil and tar which is a by-product from Briquetting and Carbonisation Plant. One of the boilers alone has been designed to burn the surplus carboniser gas from the B&C Plant. Light Diesel Oil (LDO) is used for initial light up in all the three boilers.

The fly ash in the flue gas is collected in the mechanical dust cyclone separators before the flue gas is let out into the atmosphere through a 60 m high steel chimney for each boiler, designed to minimise air pollution.

HYDROVAC SYSTEM

Bottom ash and fly ash are handled by hydraulic sluicing as in the Thermal Power Station.

WATER TREATMENT PLANT

A 250 cu.m/hr demineralised two stream plant is available to meet the boiler feed pump requirements of PSP and heat recovery boilers of Fertilizer Plant. The regenerated effluent is neutralised to be alkaline, in a neutralising pit before being let into the effluent channels of Fertilizer Plant.

NEYVELI AND THE ENVIRONS

Location

Neyveli is located 200 km south-west of Madras in the South Arcot district. Metre guage rail link of the Southern Railway connects it to Vridhachalam and Cuddalore. Neyveli is well connected by all weather roads to nearby towns like Vridhachalam, Cuddalore, Chidambaram, Panruti and Pondicherry.

Meteorology

Neyveli climate is tropical and is largely influenced by the conditions in the Bay of Bengal which is about 45 km east of Neyveli. The relative humidity at Neyveli is 26 to 78% in summer and 40 to 97% in the monsoon months.

There is a prolonged dry season from January to June when the mean daily maximum temperature is between 33 and 37°C. Occasionally the maximum temperature crosses 40°C in May. The onset of south-west monsoon winds (July to September) brings some relief to the region. During the north-east monsoon (October to December), the mean daily maximum temperature varies from 27 to 31°C. The coolest months are December and January with minimum temperature dropping to 20°C and lower. The evaporation rate is rather high during the summe months being 10 to 12 mm a day in May. The average annual evaporation rate is about 1800 mm.

The wind velocity varies from 10 to 70 km/hr. A maximum velocity of 129.6 km/hr was recorded during the cyclone in August 1979. Cyclonic weather is encountered almost every year during the northeast monsoon period. Wind direction is as follows:

Wind Direction	No.of days/year
E	45
NE	98
N	8
NE	4
W	18
SW	85
S	23
SE	70
Calm	14
Total days	365

The average annual rainfall is 1200 mm. Nearly 78% of the precipitation is received from the north-east monsoon during October to December. The south-west monsoon accounts for some rainfal. An analysis of the rainfall data from 1958 to 1983 shows that the number of rainy days per year ranges from 36 to 103 days. The average rainfall for a period of 24 hours can be taken as less than 25 mm but a rainstorm of about 150 mm intensity is not uncommon. Only for about 6 or 7 days in a year, the intensity exceeds 50 mm.

Demographic Profile

The sprawling township of Neyveli covers on area of 34 sq.km with a population of about 150,000. There are about 13,300 quarters in the township. The township is well-planned and provided with modern facilities like banks, post and telegraph offices, hospitals, schools, shops and recreation facilities etc. Water supplz to the township is proivided by a series of well-distributed borewells with overhead tanks. The major population centres within 40-km radius are Cuddalore (127,600), Villupuram (77,100), Chidambaram (55,900), Vridhachalam (42,100) and Panruti (43,000).

Land and Landuse Pattern

The commonest type of soil found in township area is red soil, derived from granitic gneiss and crystalline schists. Red soil is acidic and generally poor in nitrogen, phosphorus and humus. In the exposed and weathered location process of laterisation is observed. The lateritic soil contains little of silicate minerals and is generally poor in nutrients.

The locality was originally a small shrub forest. Here and there were a few groves of cashew and tamarind. Major portion of the area has seasonal crops, irrigated by rain-fed tanks and water drawn by bullocks from wells. Part of the land is also irrigated by bore-well pumps. Dry crops like millet were also raised.

There are no flora and fauna specific to the area.

Township and Tree Plantation

Trees have a salutory effect on the environment. The dense foliage of the trees filter dust from the air and absorb it, thus purifying the atmosphere. Trees also serve to attenuate the intensity of noise and reduce the wind speed. They have a marked effect on the microclimate and improve moisture retention of the soil by shedding dead leaves to form humus.

NLC is aware of the significance of trees in maintaining a healthy ecology and hence launched a massive programme of tree planting to cover vacant areas, avenues and the residential areas. Trees like Delonix regia (Gul Mohar), Parkia bigiandulosa (cannon ball tree), and Abbizzia lebbek (vagai) have been planted along the avenues. Details of trees planted during 1982/83 and 83/84 in Neyveli area are given below which include not only exotic varieties like subabul and eucalyptus but also native ones like cashew and tamarind. The number of trees planted so far works out to 200 per employee.

Trees planted in township, spoil banks and the on-going project sites are as under:

	Total
Eucalyptus Hybrid	1388,834
Casurina equisetifolia	645,175
Bamboo (Dendrocalamus strictus)	117,500
Subabul (Leucaena leucocephala)	226,730
Acacia auriculiformis	207,883
Cashew and other fruit trees	3,500
Silk Cotton etc.	400
Agave mexicana	508,500
Eucalyptus citriodara	76,530
Tamarindus indica	14,600
Achvan	25,100
Other plants	43,448
Total	3350,700

As the Neveli soil is suitable for raising jack, citrus and kapok trees, the residents, have grown them in their gardens/compounds. The Horticultural Department of NLC raises nurseries and transplants them at different places in the vast area. During the planting season, it distributes saplings of eucalyptus. subabul and silk cotton to the residents, free of cost.

A timber treatment plant, based on As-Cu impregnation has been installed in Neyveli. This chemical treatment renders low grade timber fungus and termite-proof and dimensionally stable. The treated timber with better functional and weathering properties, could feed a number of timber-based industries besides Neyveli's own construction activities.

In order to prevent dust nuisance, most of the roads in its township have been topped.

Pollution Monitoring

NLC maintains a well equipped Centre for Applied Research and Development, where facilities have been provided to monitor pollution also. Air samples for determining the content of SO2 and particulates in the ambient air are collected and analysed. A network of sampling stations in and around the township has been.

identified and regular samples are collected at these points and analysed in the laboratory.

The flue gas analysers for the analysis of oxygen, carbon monoxide and dioxide, sulphur dioxide, nitroigen oxides etc. have been ordered for NSPS Stage-I and similar instrumentation will be procured for Stage-II also.

CONCLUSIONS

In brief, the following anti-pollution measures have been adopted in NLC to alleviate the adverse effects of pollution.

1. Even at the stage of project formulation, evaluation of environmental factors has been made and certain safeguards built-in, such as suitable design of tall chimney stacks and provision of electrostatic precipitators of required efficiency in Thermal Power Stations.
2. In order to reduce dust nuisance, hydraulic handling of fly ash has been adopted in thermal stations, the effluents being discharged into a suitable ash dump, long enough to settle the deposits so that clear supernatant water only will be surplussed to a suitable drainage system.
3. NLC is well aware of the importance of maintaining a healthy ecology and the role of greenery therein. A master plan has been prepared with the assistance of a Forestry Consultant and a massive afforestation programme has been launched in the project area, including the township. This scheme will also stabilise and revegetate the soil dumps of the mines and arrest wind-blown dust and erosion of the dumps.
4. Adequate measures are taken to minimise noise pollution by specifying suitable machinery and equipment and their proper maintenance.
5. In chemical plants, gaseous pollutants are burnt atop flare stacks and liquid wastes are suitably treated, diluted to safe limits and then discharged into drains.
6. Facilities have been provided in the Centre for Applied Research and Development (CARD) for monitoring pollution in the Neyveli area by collecting air and water samples and analysing them.

Thus, it may be seen that adequate safeguards have been provided in Nyveli for a healthy environment. Neyveli has proved that industry and healthy environs need not be antithetical but can co-exist for the benefit of mankind.

HERITAGE STUDY: A CASE STUDY OF HAMPI RUINS

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Magnitude of cultural heritage at the site of the ancient metropolis, Vijayanagara city (1336 AD to 1565 AD), now popularly known as Hampi Ruins, can be visualised only after making a visit to that place. Even in its present ruinous state, the edifices left behind by the Vijayanagara generation are so numerous, so varied from the point of purpose and use, so richly embellished each in its own finish and execution, and so extensive in their spread that they rouse the admiration of every visitor, be it a casual, an enlightened, a serious or a scholarly visitor. With some sensitive visitors this admiration turns to one combined with a feeling of shock and pity. When this is the rank condition of the site, there cannot be any over estimation or exaggeration in the words of Abdur Razzak, Persian ambassador to the Vijayanagara court in 1443 AD when Devaraya II (1424 to 1446 AD) was the ruling king. He declared '....that the eye has not seen nor the ear heard any place resembling it upon the whole earth'. The economic prosperity of that great city was of such high degree that the Portuguese Chronicler, Domingo Paes who visited it in 1520 AD was awestruck on seeing it and has gone on record stating that diamonds, pearls and other precious things were displayed in heaps in the open markets and were sold by measures. What a prosperous and peaceful kingdom it must have been. In support of this, there is a legend current even now in this region which narrates that there was as rain of gold coins at this place, in the beginning of its founding caused by the sage Vidyaranya, and so on. All these point out their achievement of peace, economic prosperity which led to the stupendous cultural attainments of which a small part is the present Hampi Ruins left for us. It is recorded that the victorious armies of the Sultans of Deccan, even after carrying out vandalism, plunder and destruction by staying in that capital for nearly 6 months, could not completely wipe off the achievements of Vijayanagara people. Probably in the history of the whole world, no where a capital site of that mangnitude and prosperity was subject to so much destruction, pillage and plunder at once as this Hampi. Even in the present state this cultural heritage must be conserved and preserved for the present generation as well as for posterity.

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The time has arisen now to give serious thought and consideration in this dirction. Our cultural heritage never before faced such grave threats of disappearing or being obliterated as today. It may not be sudden but gradual. The process is at work. The forces and factors involved in this process are various and they come from various quaters too. The situation has become all the more serious and aggravated in the present day society which is expanding rapidly in population, industrialisation, agricultural operations, building of residential quarters and so on.

Hence everyone has to develop an awareness of this heritage, recognise its importance and become consciousness of conserving it. Thereafter one has to device ways and means in that direction and ultimately implement in all sincerity and seriousness. This noble service is demanded from every one of us, by our country's great cultural heritage. And Hampi Ruins is one of many such sites.

Now we shall examine some of such threats to which the monuments of Hampi Ruins are exposed or subjected to and the ways and means of avoiding them or preventing them.

In this direction, the primary factor is the administrative authority. It is anybody's experience and conclusion that there should be a single authority, in order to have effective control on what is planned and executed. Today, most of the monuments are under the control of the Archaeological Survey of India: few of them are with the Archaeological Department of the Government of Karnataka, while others are under control of the State Department of Religious Endowments and Charitable Institutions. These are besides the departments of Revenue, P.W.D. (Irrigation & Roads), Electricity Board of the State Government which have their own spheres of control and activities in the same area, in the midst of the Ruins, close to the monuments, around the monuments and so on. Even the excavations that have been taken up in recent years, and now in full swing, are by different organisations. It is needless to state how such state of affirs, iof not in the beginning but definitely in the long run, result in non-cooperation, non-coordination in planning and execution, disowning of responsibility, clash of interests etc., at the cost of the sacred duty to conserve this cultural heritage. The best solution for this is that there should be a single authority for the Hampi Ruins: say a Director, assisted ba a team of properly qualified technical staff etc., His sole concern should be Hampi's Cultural Heritage in thinking, planning, action, and all his activities, day in day out. He should be devoted and solely responsible officer. And most important is that he should be not only well conversant in the Vijayanagara history, its culture, its literature, its languages etc., but also have practical feeling and approach towards his assignment. Further, his office should be located either in Kamalapur or Hampi, close to his job and not far away places like Bangalore, Mysore, Hospet etc. He must live with his assignment and in the midst of it. He should not become one visiting periodically and satisfy himself by giving elaborate inspection notes and then forget the whole including institutions till the next inspection. He should be constantly and intimately associated with his assignment all the time and be doing full justice.

Then come other problems. In the past, agricultural operations have been freely, and liberally allowed by different authorities. As a result we see wet cultivation in the middle of the 'Ruins' sometimes very close to the monuments or in between the monuments and so on. This can be seen near the monuments like the Chandrasekara temple, Octagonal Bath, Elephant Stables, Jain and Siva Temples, Badavi-Linga Saraswati temple, Krishna Bazar, Ugra-Narsimha, Soli Bazar etc., to name only a few. It is needless to state that quite a large number of places there are encroachments by the motivated agriculturists. The solution is that whole of the 'Hampi Ruins' should be declared as a protected area and it should be passed on to a central authority for protection and conservation. It may not be improper if the presently cultivated lands are acquired by the government after paying compensation or so. This will not only facilitate the conservation work in the 'Ruins' but also save some of the monuments presently affected by waterlogging, percolation of water, capillary action of dampness, under cutting of the foundation, as can be seen in the Siva Temple, Sooli Bazar, Krishna Bazar, Urga Narasimha, Fort Wall, gateways etc. Thereafter, feasible areas and selected spots can be converted into archaeological gardens, oif course keeping in view primarily the safety of the monuments and environmental cohesion, in order to beautify whole area and make it pleasing asnd enjoyable to the visitor.

Next step in the proper conservation of Hampi Ruis should be to prohibit the whole area for cattle-grazing, firewood cutting, stone quarrying and such other activities which create a nuisance. Particularly, herds of cattle moving about without any restriction not only make all approach roads ugly and filthy with their droppings, but also damage the monuments specially the delicate structural remains exposed in the recent excavations and so on. Unwanted jungle clearance, grass cutting can be allowed by the proper authority on occasions and as per the need but without forgetting or overlooking the principles of conservation of such cultural heritage.

Again, the whole area should be prohibited for the construction of any modern structures including huts or hutments, for whatever purpopse they are meant for. In this connection it may be mentioned that the Jain establishment on the Ratankunta hill of Hampi is a great eye-sore, not only at the spot but even from a distance. It may not be feasible at this stage to do away with these. At least these buildings can be given colour-wash externally which can make them merge with the environment. At present they have been given white lime-wash, and as such they are seen glaringly from miles. At the same time further constructions are to be prohibited strictly. Similarly, the canteen building of the Karnataka Govt. Tourist Department near the Hazara Rama Temple is quite undesirable. This needs to be hidden by raising a tall and thick shrubbery all around, as is done at other places by the Archaeological Survey of India. The purpose for which this has been constructed also required to be reviewed and action taken to have optimum use of it which is not the case at present.

The present Archaeological Museum building having been located a bit away appears to be disconnected with the unit of 'Hampi Ruins'. When the whole area is protected, it should include this Museum also. This museum should become part of the organisation for the preservation of Hampi Ruins. The visitors should have access to it right from the main road, the intervening modern buildings belonging to the local rural cooperative society, rural dispensery, school etc., are acquired, compensated and demolished since they also obstruct the general environmental setting. The museum is a supplement to the study of the monuments. Hence it is a part of the site both for preservation of cultural objects and presenting them in proper perspective for the benefit of the public in their study of the site, its history, culture and so on. It has an important role to play on these aspects in the days to come, like any other museum. Keeping this potentiality of the museum in view, the above action is also necessary irrespective of the monetary aspect.

Next is the Hampi Bazar (car-street) which demands the attention of all those interested and concerned in the preservation of our cultural achievements of the past. As we all know it is one of the classic styles left to us by Vijayanagara generation. It is a long and wide street in front of the famous Virupaksha temple, flanked on either side by colonnaded running pavillions (Mandapas). At places they are even storied. All these are built of stone and in the typical Vijayanagara style of architecture. A car-street of such dimensions and grandeur is no where seen in our country. Alas, it is left to its own care, only to be misused by selfish, uncultured, uneducated exploiters who have spoiled, desecrated it to suit their conveniences, tastes and interests. Yet it is heartening to see that major part of it still bears its original look, though in ruinous condition. Hence it is not late, even now, to take appropriate steps towards preserving it. In this direction, the first and the foremost thing to be done is to declare the whole bazar a protected monument. Some parts, particularly those at the western end (near the gopura of the temple) have been occupied by the local people and converted them into shops or residences for carrying out their business with the pilgrims and visitors who come to this place in large numbers. While doing so, they have retained, rather utilised in most of the cases, the original framework of the structure at the same time making some alterations and additions as per their necessities. As a result some of them have lost their original outlook. Besides many of thme have been painted in a bad taste, in all sorts of shades popular amongst commercial people.

It is needless to state that all this is not desirable when our aim is to conserve the cultural heritage in its original form and appearance as far as possible. Towards this goal, action is to be initiated with priority, as already suggested above and declare them as protected national monuments. Next step should be to take appropriate measures to preserve them, as they have not been attended to for centuries except where they have been utilised by the present occupants. Some of them need urgent repairs. Unauthorised occupants should be allowed to stay on condition that they should never meddle with the structure, particularly the external appearance (front side) towards the bazar. Even the open space in front of their occupied part should no be utilised for any other purposes like keeping cattle, goats, other animals, providing thatched shades, canvas shades, putting water-tubs, benches, lumber material and so on. Even the name boards those not too prominent can be allowed but in consultation with the Director of the place. Where the facade has been altered by the present occupants, it should be redone to be in conformity with the original one. They must be told to restrict their domestic activities to the interiors and to the rear side only.

Another important step to be taken here is to provide public toilets at suitable places for the use of the local residents, pilgrims and visitors. At present this aspect creates horror in the visitor. Even the areas around the Virupaksha temple, some parts of Hemakuta hill are not spared from this public nuisance. The ancient approach to Virupakash tremple from behind the Kadalekalu Ganesh temple is simply disecrated beyond words. This should be checked by providing alternative ones and by being vigilant over the violations. Thereafter, whole of Hampi Bazar should be maintained in accordance with the principles of Archaeological Survey of India. If need be, the bazar can be put to use for habilitating local people but without meddling with the original appearance of the frontage. This will mean some human activity in these buildings though not in the same degree as in the Vijayanagara days.

Currently excavations are in full swing at Hampi sanctioned as a national scheme. This work has been distributed to different organisations. Here again in order to have a planned, systematic and comprehensive work, there should be only one organisaion, however magnitude the work may be. At least the Director, the over-all in charge, should be one and he must be on the spot. Secondly all the objects recovered during the course of the excavations, irrespective of the organisation involved are to be available near the site. The visitor to Hampi site should never be denied access to them. Therefore, straight from the excavated field, the objects should go to a museum located near the site.

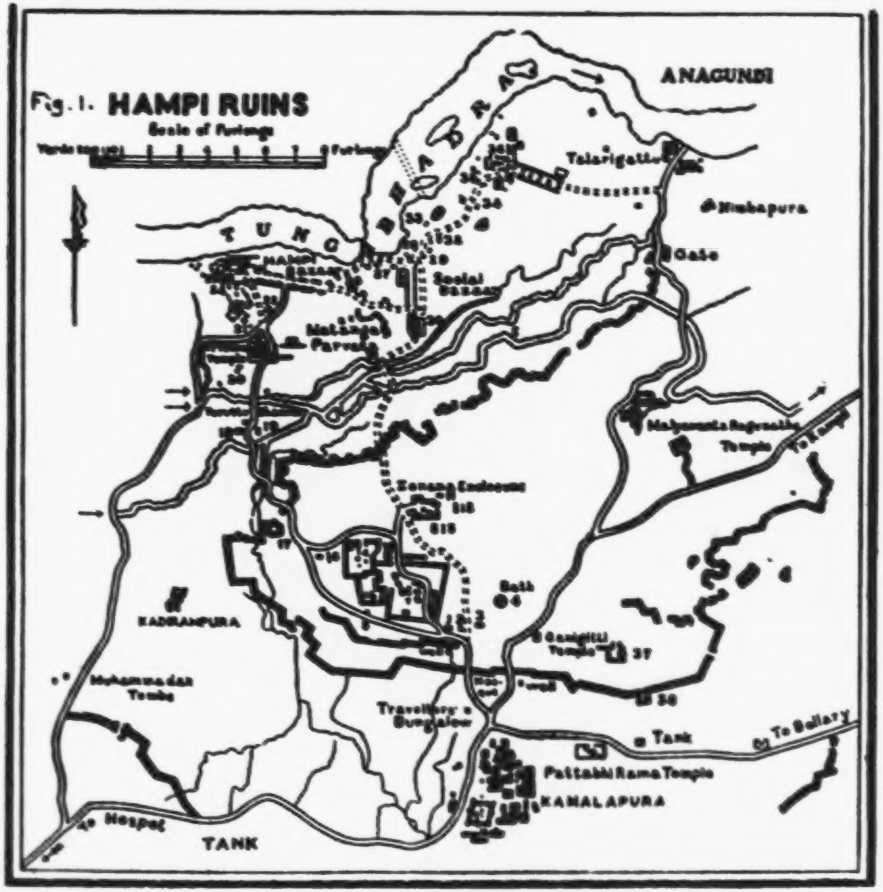
Fig. 1. HAMPI RUINS
Scale of Furlongs
Yards 220 0 1 2 3 4 5 6 7 8 Furlongs
ANAGUNDI
TUNG
BHADRA
HAMPI BAZAAR
Talarigattu
Nimbapura
Gate
Soolai Bazaar
Matanga Parvat
Malyavanta Raghunatha Temple
To Kampli
Zenana Enclosure
Bath
Ganigitti Temple
KADIRAMPURA
Muhammadan Tombs
Travellers' Bungalow
Tank
To Bellary
Pattabhi Rama Temple
KAMALAPURA
Hospet
TANK

REFERENCES.

1 Queen's Bath
2 Water Tower
3 Chandra Sekara Temple
4 Octagonal Bath
5 Octagonal Water Pavilion
6 Throne Platform
7 King's Palace
8 Underground Chamber
9 King's Audience Hall
10 Hazara Rama Temple
11 Guard's Quarters
12 Elephant's Stables
13 Ranga Temple
14 Danaik's Enclosure
15 Mint
16 Underground Temple
17 Natural Archway
18 Sati Memorials
19 Virabhadra Temple
20 Narasimha Statue
21 Sasivikalu Ganesa Statue
22 Kadalaikalu Ganesa Temple
23 Hemakuta
24 Group of Jaina Temples
25 Pampapati Temple
26 Monolithic Bull
27 Kodanda Rama Temple
28 Varaha Temple
29 [illegible] Temple
30 Achyuta Raya's Temple
31 Steps leading up Matanga Parvatam
32 Jaina Temple
33 Sugriva's Cave
34 King's Balance
35 Unfinished Gateway
36 Vitthala Temple
37 Bhima's Gate
38 Domed Gate

The museum already there at Hampi should receive and take steps to put them on show immediately. They should not keep them in its store or godown either. They should be documented in all respects immediately and the most interesting ones displayed suitably for the information of the public. Such steps not only ensure their safety, but also their availability to interested public as well as to departmental personnel. This way, these movable objects are also to be preserved for posterity.

Now, a word about the structures exposed during the course of excavations. Normally these are likely to be neglected in the long course of time which means they would be lost for ever. But they are also to be preserved taking all pains. It is true that preserving the structures exposed during excavations is tedious, expensive and a continuous process. Becasuse these are normally not so solid structures; they wil be of small heights; thin lime plaster layer seen in some cases will be quite weak and fragile; the bricks will have no strength and so on. In order to ensure their proper preservation, only a devoted person should be entrusted with this responsibility. He must be assisted by a team of patient and skilled workers. Over all this, the Director of the whole project should be going round the site constantly and take adequate and timely steps topreserve them without any lapse of time or negligence in the least degree.

In addition to all, there should be cooperation from the public too, particularly of the same locality, nearby town for towns and the local government. The enlightened people of this locality should volunteer to assist authorities in the preservation of our cultural heritage. They must get actively associated and involved. In order to enlist such cooperation, to creat awareness, to encourage involvement, an advisory committee should be formed which should meet periodicaly and advice the concerned authorities appropriately and without any bias or personal considerations. This is how that all of us can render due service to the mankind by preserving the cultural heritage.

HERITAGE CONSERVATION OF NATURAL PROTECTED AREA: A CASE STUDY OF LAHUL AND SPITI

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INTRODUCTION

ANTHROPOS, Man, had developed his own anthroparea, depending upon the basic needs, and laboured upon the surrounding environment for his survival first. Later his behaviour tilted towards mass exploitation of the natural resources of the biosphere.

In the present age human activities exert enormous influence on the natural conditions of the entire planet. Changes in the flora and fauna of land areas are particularly pronounced. Many types of animals have been completely destroyed by man and still a greater number of species are threatened with extinction. Plant covers have experienced enormous changes over a large part of the surface of various continents. Man's influence has also affected the process of soil formation in the corresponding regions and has led to changes in the physical and chemical properties of the soil.

It is seen that even though the activities of modern man have altered the natural environment of our planet, these changes usually represent a sum total of local influences on the environmental process. It is not as a result of changes by man of global natural processes that they acquire a global character, but rather because local or regional influences are disseminated over large areas.

Therefore, we have selected a small area in the Himalayas protected naturally by natural barriers and State Government through protection of forests, viz. Lahul and Spiti District of Himachal Pradesh, to study and evaluate the heritage of the area which is still not that badly explored by man and where his diabolic behaviour has not yet altered the natural environment to a point of no return. But still with the advancement and the invasion of urban behaviour along with the advancement had been rendered by the State Government or any other scientific institution to fulfil the basic needs of life during the adverse climtic period which embraces for major part of the year.

The present study deals with intensive survey of the hilly area keeping in view its previous heritage and the present life patterns along with the conservational steps taken by the hilly people themselves which help them in restoring their fast losing heritage plus the environmental degradation.

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PHYSICAL FEATRURES

The Lahul and Spiti district with an area of 13,688 sq.km lies between 30° 41 · N and 32° 59 · 57" N latitudes and between 76° 46 · 29" and 78° 41 · 34" E longitudes. It comprises mainly of two valleys, Lahul and Spiti, which differ from each other in their physical features. Spiti valley is broad, enchanting and completely rugged without any verdure worth the name whereas Lahul Valley is narrow and too steep studded with green patches of poplar, willow and conifers.

The main amongst the numerous rivers in Lahul being Chandra river originating from Lake Chandra near Baralacha la extending upto Tindi, and the river Bhaga originating from Lake Suraj below Baralacha la and joining river Chandra at Tindi. Beyond Tindi both the rivers amalgamate into Chandra Bhaga or the Chenab river. In the Spiti valley, the river Spiti originates from the heights of Kunsum la and swallows on its way numerous rivulets and rivers like Pin, Lingti, Gumto and Parechu rivers. Closely associated with the high elevation and snowy mountain ranges are the glaciers and ice caves, the famous being Bara Shigri (one of the largest in the world), Chotta Shigri, Gangstang, Sonapani and Perad glaciers.

GEOLOGY

In the late Pre-cambrian period (more than 600 million years ago)) when the area of Lahul and Spiti was a vast sea, sedimentation started and different lithological units were deposited under different depositional environments. The area raised by the mountain building activity were subjected to erosional activity which gave the present day landscape. Thus the geology of this area is quite complicated. This phenomenon has made Spiti Valley famous for its fossil hunting ground in the world. The general classification of the rock structure based on lithology, degree of metamorphism and superposition is as under:

1. Triassic: Pink, dolomitic limestone with dark fossiliferous bands and some purple shales, e.g. certain areas in Spiti.
2. Permo-carboniferous: Massive grey limestone, carboniferous and green shales, slaty limestone and sandstones with quartzitic veins, e.g. area near Batal and Kunzum la.
3. Upper Silurian: Slates, sandstones, limestone and shales, e.g. Baralacha la series
4. Mid-Silurian: Mica-Schist within limestone bands, quartzites, calc-granulites, e.g. Keylong and Darcha series.
5. Lower Silurian: Garnetiferous Schists, ferrugineous quartzites with plenty of quartz veins, e.g. Sissu series.
6. General Gneiss: Garnite, gneiss with associated metamorphics e.g. Rohtang and Tispa ranges.

LAND FORMATION AND VEGETATIONAL INVASION

It appears that after the Ice age (20,000 years ago) when snow line started receding, the valley was subjected to water action which led to the deposition of large stones in the gently sloping valley. The alluvial deposits went on raising till the glaciers recession and the tributaries originated from them made it possible to bring down large detrital masses to spread and partly cover alluvial flats in the river valley. Elsewhere slopes and detrital masses began to be formed at the foot of the cliffs.

In the process of recession of glaciers, the vegetation advanced upwards and by retarding the flow of water from melting snows made possible for smaller particles to deposit on hill slopes, which gave birth to fertile productive land stabilized on steep slopes extending right upto the glaciers (16,000 ft.).

With the gradual change in climate and soil, there was succession in vegetation, which brought in herbs, shrubs and latter trees to the area. The invasion of forests was also accompanied by microfouna, insects, birds, beasts and later on man.

CLIMATE

Generally climate comprises of light, temperature and water (precipitation) which are ecologically important environmental factors on land. Climate on land can be classified into different types based largely on quantitative measures of temperature and moisture by taking into consideration the effectiveness of precipitation and temperature and seasonal distribution as well as the mean value of light, temperature and water (Thornthwaite 1948).

In a broader sense, the climate of Lahul and Spiti can be categorised into 4 seasons. The spring commences in middle of April and the autumn in mid-September to early October. Water along the springs, streams and river beds get frozen during the winter and heavy snow fall is received throughout the winter season which lowers the mercury to even -40°C in some cases. However, a temperature of -20°C is normally observed. During the summer, strong winds lash the entire area causing excessive dust storms. The climate in general is dry and cold but still healthy for living.

EKISTICS

The linguistic studies of the area indicate that it was invaded by an aboriginal tribe who in language as well as stock were analogues to the Munda tribe of Bengal and Central India in about 2000 B.C.

Later, the area was invaded by Tibetans upto river Chandra through Spiti and by the Aryans and semi-Aryans from the West and South of Lahul through different stocks which settled there.

It is noted that from 6th to the early 19th Century the area was a battle-field for the Kings of Kulu, Chamba, Ladakh, Tibet and later also the Sikhs. During the British period Moravian Mission was set up in mid-19th Century. Some Missionaries did a valuable historical and archaeological work there. Thus, valleys of Lahul and Spiti had set up their own anthroparea by borrowing social norms and living behaviour from neighbours and invaders. The fact being confirmed by the features of the Lahulis even today which depict a combination of Mongolian and Aryan traits and the Spitians depict purely mangoloid race.

A CASE STUDY OF EKISTIC ELEMENTS

A case study is a way of organising social data so as to preserve the unitary character of the social object under study. Expressed somewhat differently, it is also an approach which views any social unit as a whole.

According to Doxiadis (1977), ekistics comprise of five elements which compose human settlements: Nature, Anthropos, Society, Shells and Networks. Thus the case study of Lahul and Spiti is delimited as per the definitions and the ekistic is covered separately under different element heads.

Nature

The term Nature here refers to indicate the natural environment of anthropos, man, before he starts to remodel it by cultivation or construction. It can be presumed without doubt, that when man invaded this area, he was not of a barbaric nature, but had a gregarious behaviour in the form of a tribe or a clan and it also rules out the fact that he was not familiar with the basic principles of building shelter and cultivation. Thus small settlements came into existence from the very start.

The nature around him was rich in natural wealth with abundent of wood (for building and fuel) and water (for drinking and irrigation) which not only provided shelter but also fulfilled his basic needs for survival.

Anthropos

It stands for an individual with his own characteristic and problems as distict from society. Anthropos round about 600 B.C. would have invaded the area due to certain characteristic problems or problems of the clan or tribe, which can be as the instinct of invading nature for better lands or the fear from the neighbourhood that forced him to seek shelter in the vegetation-studded area under the high ice.

Society

In a human society, with all its charcteristics, needs and problems, the individual is not treated as an individual, but a part of the society. Society in general covers many of the broad features by which the individuals are influenced or effected upon directly or indirectly, such as religion, social mores, language, and occupation which are taken up in detail below:

Religion: The people of Lahul are overwhelmingly Budhist. It all started in the 8th century when the great Lord Padma Sambha visited the valleys of Lahul and Spiti to preach Buddhism. The religion found a much more stronghold when Buddhist saints in 11th Century founded new monasteries which even today stand in good conditions as in Gumrang, Sissu, Udaipur and Tabo. Also the Hindu temples on the Udaipur side depict the presence of Shiva religion.

During the British period, many Missionaries had invaded and preached Christianity. A few families are still present with little influence of Christianity.

The presence of Buddhism had made people of a loveable nature. They believe in non-violence. The food habits are also effected by the religion as a few families are still vegetarian. The main drawback for Christianity was that the Missionaries indulged in consuming beef which the Buddhists were against. But the consumption of Yak is still present on the Spiti-Tibet border belt and this could have developed due to two main reasons: firstly, the Spiti valley was more influenced by the Tibetans, and secondly, due to the shortage of food.

Social Mores: The people of the area have very little inhibitions to face. Both the sexes mix freely without any resistence and love marriages are comon even today. The valley of Lahul previously supported polyandry system but at present this system has nearly come to an end. In the valley of Spiti both monogamy and polyandry still persists, where only the eldest son in the family was allowed to marry and the rest had to do service for them. Thus maximum number of youngsters were converted into Budhist Monks. It is observed that polyandry in the past acted as a double-edged sword by stabilising agricultural economy and by also controlling population to some extent. But the exploitation in Spiti valley still persists and thus the presence of bastards in the valley is observed. The social celebration in both valleys consists of a feast mainly of meat and strong local brew.

The entire population can be categorised into three major types of tribes viz. Swanglas and Lahulas in the Lahul valley and the Bodhs in the Spiti valley.

Language: The Lahul valley has three major languages- the Bunam, Tinan and Manchat. All these languages have strong affinities with the Mund language of the pre-Aryan times although the vocabulary is borrowed directly from Tibetan language. In Spiti valley pure Tibetan is spoken as it had a direct link with Tibet.

Occupation: The people in both valleys are short, sturdy and very hard working due to the ethonographic cross breeding. Before the beginning of modern communication system, male folks spent their time plying mules and the women folk managed every work right from cooking to agricultural fields. But now, with the modern transport system, men are seen doing trade outside the area and women still work in the fields for plantation of cash crops as seed potato, kuth and hoops (mainly). The cash crops have revolutionised the economy of the Lahul valley to a great extent with the result the education system has boosted up. Many people today hold high posts even in different fields of administration, medicine, engineering and education.

Shells

Shells include all types of structures, used by anthropos for living in or for the accommodation of animals, machinery, produce manufacturing etc., the structure within which and by which mankind lives and carries out his different functions.

Thus, the anthropos in a society marks the most complicated part of the study. This includes various aspects and some of them are major and important which are directly related to the needs of survival of anthropos.

House: Most of the houses in these valleys are built from the locally available materials only. The houses made of wooden logs, stones and mud are spacious, with 3 to 4 storeys. The houses are of strong and thick walls with small windows and doors and flat roofs of mud. The ground floor is reserved for the livestock and stores. First floor comprises mainly of the sitting plus the kitchen with a tandoor (cooking cum heating appliance) in the middle of a spacious room. Other rooms are occupied by the different family members as their own personal rooms, although there is no restriction for the family members to move from one room to another. Each house has its own latrine which is double storeyed. The ground storey serves as a store for human waste which is utilized as a fertilizer. At present in new constructions the same pattern is followed but mud is replaced to a certain extent by cement.

Agriculture: Agriculture in Lahul and Spiti district is the main occupation of the overwhelming number of households. Previously many forests were cut down in the vicinity of the villages for the purpose of agriculture (which is now banned both by the people themselves and the State Government), and the agricultural products were of less economic use such as barley, buckwheat and some pulses like peas, oil seeds and kuth etc. At present with the opening of modern transportation system through roads, the agricultural habits have been altered and main emphasis now, especially in the Lahul valley, is given to the production of cash crops such as seed potato (disease free variety), hoops (recently introduced) and kuth. Horticulture includes orchards mainly comprising of apple plantations in the lower bit rocky soils of the valley.

Live Stock: Primarily the Lahulis lead an agro-commercial life and Spitians a predominantly agro-pastoral, with livestock population outnumbering even the human population. May it be the valley of Lahul or Spiti, livestock was and will be a basic need of the people. It comprises mainly of cattle (both local and Jarsee), sheep, goat and hen. The livestock, not only provides the non-vegetarian food, but also milk, butter, woolen clothing and also assist in agriculture. The local cattle when crossed with wild Yak, produces an offspring named chirru which provides high yielding milk. The chirru is small, strong with thick wool and hair growth, and is domesticable, mainly used for ploughing and cross breeding. An interesting phenomenon results if chirru is further bred with local cow, the offspring upto the fourth generation are domesticable whereas further offspring turns or rather acquires more of wild characters and has a tendency of returning back to its native place- the forests.

Fuel: Fuel requirements of these areas is tremendous, as the tandoor is kept hot throughout the 24 hours. Previously fuel was brought mainly from the forests, which had an adverse effect on forestry. But now plantations of willows (social forestry) by the village people and the individual families, have reduced the pressure of illicit felling to nil. Another way of producing fuel by making cow-dung cakes too has come into practice. The import of sheep and goat dung to Spiti is a unique phenomenon which not only is used in the tandoor but also in the fields as a fertilizer. The willow trees are cut from the top at a height of 10 to 15 feet and the twigs kept in store for drying. Here the bark is utilized by the sheep and goats and the remaining wood used as fuel.

Water: Water for household and drinking purpose is fetched from a tap fed by spring water. For irrigation purpose water is diverted from the spring or a small glacier rivulet and distributed to all the fields of village without any priority in a well cooperative manner.

Forestry: The excessive felling of trees in the past has affected forests to a great extent, which has not only resulted in excessive erosion but also have increased the efficiency of avalanches. Now the people have realised the danger and are trying to counter the same through social forestry. Thus in every growing season, large number of new plantations near the villages and the foot-hills are coming up. The main plantation by the local people under social forestry programme of willow, spruce and pine varieties. If any person is seen fetching firewood from these areas, a fine is imposed by the villagers themselves.

The State Government has also introduced a desert development programme for the development of these regions. The major species growing in both the valleys are: junipers, poplars, blue-pine, willows, birch, spruce and walnut trees. Common plants are roses, and species of Juniperus, Artemisia, Ephedra, Gataegus, Viburnum, Fraxinus, Berberis, Prunus, Spiraea, Lonicera, Myricaria, Hemerocallis, Iris, Anemone, Ranunculus, Caltha, Potentilla, Sibbaldia, Pedicularis, etc.

Grazing: All protected forests are open to grazing rights unless closed by order of the State Government. The bare slopes support excellent grazing grounds during the summer but during winter (nearly 6 months) all the pasture land is under snow and the cattle have to be stall-fed.

A great many gaddies from Kulu and other shepherds migrate to Lahul and Spiti during the summer season in the upper part of the main valleys, which are uninhabited and to grounds high above the villages in the inhabited regions. In all, there are 91 runs where gaddi grazing is done.

Wild Life: Wildlife, mainly of migratory type is very important for the people, as most of the animals are seen descending to lower altitudes during the winter months. The herbivores like Yak and wild sheep are seen going from one place to another searching vainly for food, turning up snow with their horns and eating nearly anything that they can find including remnants of old straw, grass roots, tree barks and even rage. Similarly carnivores like snow leopard descend down and hunt upon herbivores and even the domestic livestock. Humans indulge in hunting of wild goats and snow cocks for meat. During winters wild Yak is also captured and kept for cross breeding.

Industry: There is no heavy industry in both the valleys. The only industry is that for drying the hoops, situated near Tindi. It comprises of a drying room and a hydraulic press. This is used by growers during September and October for drying of hoops to increase the commercial value of the produce.

Networks

The term network here indicates the man-made systems which facilitate the functioning of settlements such as roads, water supply and other lines as electricity, telecommunications, etc. The importnce and major network systems are:

Roads: The area of Lahul and Spiti have only two main roads and nearly 80% of these is motorable but with very little mettled part. One road runs from Manali and ends at the foot hills of Baralacha la, with an offshoot from Tindi to Udaipur. The only road for Spiti is from Gramphoo, which traverses through major part of Spiti from east to west and ends up in Kinnaur district. Most of the villages are connected to the main road through mule tracks and the materials may it be of household need or agricultural produce, are transported on mules to and fro. In winter emergencies are covered through chopper service run by State government on subsidised rates for headquarters Keylong and Kaza.

Water Supply: Practically, there is no work done on water supply system except that the spring and rivulet waters are directed to the village by the villagers themselves for household and agricultural needs.

Electricity: Major villages lying on the roadside upto Keylong are electrified. Small thermo-generators are set up at many places which do not supply sufficient power.

Erosion

At present the soils in this area are very inadequately protected by vegetation, but when given protection, grass and herbs on the upper slopes and trees on the lower slopes come up in due course. The result today is that the steep and extensive slopes in the area are eroding fast with throwing snows and avalanches in winters. During early summer to autumn wind erosion is causing havoc in the area. Water erosion is gathering momentum day by day. It was observed that major part of the alluvial flats, detrital fans and slopes have already been washed away, and the Lahul valley at present contains vestiges of the alluvial soils are washed away. It is no exaggeration but shame on the name of humanity to say that detrital masses which make life possible there are on the move. The way the rushing waters are cutting into them and the enormous quantities that move down to the rivers have to be seen to be believed. There is enormous effect of erosion near the settlements and the grazing sites due to excessive grazing from early spring to late autumn. It is observed that the combined action of snow, avalanche, water and wind has all the effects like deflation, attrition and abrasion throughout the area and has resulted in the invasion of deserts. The diabolic characteristics of desertification are projected through the formations of mushroom growths, zeugen, yardang and dreikantisation of the soil and land.

Ethnobotany

With the development of anthroparea, anthropos developed its own techniques of curing diseases, clothing, food and other things. The local doctor (Vaidh) has his own medicines prepared totally from local herbs, shrubs and other things which are very effective in curing both common and complicated diseases. The problem arises that the technique is passed on to only one in the next generation through practice and orally. Woolen clothings are made from the pure wool of goat, sheep and Yak, spun at home through traditional means only. Although now factory made garments and wool are also used, but to a limited extent only as these are not warm enough. Locally hand made shoes (Pullee) from the hemp of bhang and local leather are still in use as these are more comfortable and also do not slip on snow and ice. The local brew is from barley and rice with the help of a yeast produced locally by only a few people who do not transfer the technique to any other person until death. Other seeds of wild grasses and herbs are also consumed to a limited extent. Some of the other important wild collections are of precious stones, karu, potish, zira and other forest produce.

HERITAGE CONSERVATION

As the study indicates, the district of Lahul and Spiti supports a fragile ecosystem which is tilting more towards desertification assisted first by man and now by the natural calamities too. The area still supports a rich cultural heritage and stands as a challenge to the modern man and his scientific development for its conservation.

The measures for conservation of natural heritage are being taken up by both local people and the State Government through various methods. The area is being explotied by the inhabitants at a larger scale. Hence to conserve it, following actions are necessary before any scientific development is carried out in these valleys:

1. Avalanches Control: Avalanches create havoc in the area. They should be controlled by triggering small avalanches during the winter season artificially.
2. Erosion Control: The excessive soil erosion should be controlled at a faster rate through scientific technology, by preparing check dams, planting of grasses and shrubs on the higher altitudes and fast growing fodder and timber trees on the lower altitudes. Badly erroded grasslands and pastures should be closed till stabilized.
3. Wind, Water and Solar Energy: The area throws with fast flow-

ing rivers, rivulets and winds. The thermal, wind and solar nergy should be tapped at village level through mini-hydel projects, wind mills and solar plates etc., for household and irrigation purposes. The historical lakes viz., Chander Tal, Suraj Tal and Neel Kunth are also facing problems of degradation. Measures should be taken to reclaim these.

4. Mineral Exploration: The area covered by both valleys is rich in minerals which should be utilized for boosting the economy of the country. It will also generate employment for the local people.

5. Agriculture: The modern agricultural techniques for better cropping should be introduced through improved and drought resistant and high yielding varieties for improving the economic status of the people.

6. Fuel and Fodder: One of the major problems faced by the local people is of fuel and fodder during winters which should be provided by the State Government at subsidised rates. Social forestry in the area be given top priority.

7. Livestock Improvement: High milk and wool yielding livestock be introduced by improvement of stock through cross breeding of wild and domestic animals.

8. Wool Industry: The local woolens are one of the best in the country and the wool making process be mechanised for better marketing in the country.

9. Education: Modern and higher education be imparted to the society free of cost. This would enable them to undestand their surroundings. With better education, people may move to other parts of the country for better vocations, which will reduce the excessive biotic pressure on the land. It will also help in eradication the exploitation of the weaker sex e.g. polyandry. The education concerning the planning of village; construction of cold resistent and hygenic houses should be imparted.

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WATER POLLUTION MONITORING THROUGH REMOTE SENSING

Ravi Narasimhan*

INTRODUCTION

Water is one of the most important natural resource of a country. To obtain the maximum usage out of a waterbody, we need to monitor and manage the water quality.

Remote Sensing is the science and art of obtaining information about an object, process or phenomenon through analysis of date obtained by a device that is not in direct contact with it. A camera is a very good example of a remote sensor. In stellites a scanner is often employed as a sensor. The main difference between a camera and a scanner is that, while a camera records an ntire image at the same instant, a scanner collects the reflected or emitted electro-magnetic radiations emanating from a unit area (picture element or pixel) at any instant and scans the object pixel by pixel, thus assemblkng the entire image.

It may be surprising to note that remote sensing is quite an old science. The earliest use of remote sensing dates to 1859 when a camera flown on a balloon was used to take picutres. Remote sensing through satellites is however a recent advancement in technology. Remote sensing has been widely used for crop yield estimation, acreage estimation, minerl exploration, monitoring of lumbering operations etc. The area of environmental pollution was ignored for quite sometime, perhaps because it seemed preposterous that water quality parameters normally evaluated through time consuming laboratory analysis could be determined by photographing a waterbod. Another possible reason for the neglect is that the sensors aboard the first few high resolution environmental remote sensing satellites (the LANDSAT series) were designed primarily to obtain information about the land cover. Recently a number of research workers have been studying the possibility of using satellite imagery to detect and measure pollution in water bodies (Munday et al. 1979 and Philpot and Klemas 1979).

Advantage of Remote Sensing

Remote Sensing is not simply a fancy way of gathering information. It overcomes several drawbacks of conventional methods.

1. It improves our ability to inventory and hence, manage the earth s dwindling natural resources. In order for a global inven-

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Asian Institute of Technology, Bangkok, Thailand tory of resources to be of value, it should be made in a sufficiently short time to ensure global compatibility. Remote Sensing through satellites is one means of achieving this.

2. Remote Sensing can beused to monitor changes in our deteriorating environment. Because of the repetitive coverage of the same area by sun synchronous satellites (for LANDSAT-every 18 days), the satellites lend themselves to effective monitoring of the resources especially where the resources span across international borders.

3. A synoptic overview is provided by remote sensing. An observer on a ship is limited in what he can see about the surrounding areas. A satellite image increases the overver s field of view to hundreds of kilometers.

4. Satellite images provide an instantaneous record at a particular point in time. This is particularly useful in the study of dynamic processes.

5. Remote Sensing is inexpensive. Once a viable relationship has been established between the remotely sensed data and the surface truth, it is much cheaper to acquire information from remote sensing as opposed to the alternative of expensive and time consuming field sampling teams and ships, especially when conducting seasonal or long term investigations.

APPLICATIONS

Water parmeters that affect the energy levels detected by a camera or scanner are color, turbidity, temperature, roughness of the surface, flourescence and luminescence.

The surfce temperture of a water body may be determined from emitted radiances in the Thermal IR or Microwave regions of the spectrum. Polcyn (1972) used multi-spectral scanner data to study the thermal plumes caused by power plant effluents. Without atmospheric corrections temperature differences of 1° C may be detected and absolute values determined within 2-3° C. With atmospheric correction absolute temperture values may be determined to within 1° C. Because sensing is through the e-m radiation emitted from the surface, investigations can proceed even at night.

Suspended sediments affect the general clariy of water because of their scattering and absorptive properties. Hence. Hence they also change the optical depth and the colour of the water column. An increase in turbidity increases the energy flux reaching a sensor, because more solar energy is reflected (or back scatterd) by the particles producing turbidity. Robinson and Srisaenthong (1981) observed that Landsat Band 5 (Multispectral scanner) reflectance values were highly correlated with suspended sediment load. They used a linear relationship to predict the sediment concertration from these reflectance values.

Chlorophyll-a is an important aquatic parameter that has significance for wter quality and also serves as an index for basic biological productivity. Either abnormally high or low concentrations indicate pollutant inputs. Two approaches are currently being employed for the determination of chlorophyll by remote sensing.

a. Analysis of back scattered light in
chlorophyll absorption bands:

It has been found that there is a decrease in reflectance at 460 nm and an increase in reflectance at 540 nm with increasing chlorophyll concentration (Thomas et al. 1978). By obtaining the ratio of reflectances at the above two wavelengths, chlorophyll concentrations have been successfully measured (Harlan et al., 1975). LANDSAT is not very suitable for chlorophyll determination because of the broad wavelength bands of its sensor. However, a sensor specially designed for detecting chlorophyll-a (Coastal Zone Color Scanner-CZCS) has been mounted on NIMBUS-7 (a meteorological satellite). Cracknell et al. (1980) found good agreement between the surface measurements for chlorophyll-a and the estimations through CZCS for concentrations ranging from 0.12 to 6.3 mg/cu.m.

b. Chlorophyll Determination Through Flourescence Measurements

The fluorosensor consists of a laser transmitter and receiver that is mounted aboard an aircraft. The laser sequentially transmits short-duration, high-intensity pulses of light at 454 nm, 539 nm, 598 nm, and 617 nm which in turn excites the chlorophyll in the algae to emit pulses of red fluorescent light. The returning fluorescence is measured at 685 nm and analysed to yield a correlation to the chlorophyll concentration.

Oil is one of the commonest pollutants of the sea. Remote Sensing is particularly useful for monitoring laeks from offshore drilling platforms and illegal tank washing along tanker's routes because oil remains on the surface for a long time. It is also extensively used to detect and direct the control of oil spillage. Deutsch et al. (1980) repot the use of Landsat data to track and predict the movement of an oil spill following the explosion of IXTOC-1 oil well in the Gulf of Mexico in 1979.

A variety of sensors have been used for the detection and prediction of the quantity of oil contained in an oil slick. In the visible region blue and near ultra violet bands are excellent for imaging the edges of oil slicks and determining their extent. Thermal IR bands are useful for measuring the thickness of the slick at various points. In the realm of active microwave remote sensing radar is quite effective in detecting oil slicks. Oil smooths surface capillary waves and reduces radar backscatter which is a function of surface roughness. Thus thickness determination is crude and dependent on sea state. But one main advantage of radar is that it provides all weather, day/night operation unaffected by clouds (Ulaby et al. 1981).

Often substances which are considered too difficult or uneconomical to treat are disposed off in the ocean. Typical examples are sewage sludge acid wastes and other similar chemicals and industrial waste products. These often possess unique spectral characteristics and in some circumstances, due to their method of disposal, distinct spatial patterns also. LANDSAT sensors are often particularly useful in determining the effects of dispersion and diffusion on waste plumes.

The discrimination between various components contributing to the radiance is made possible by the spectral separability of pollutants and their brightness differences from clear water. Eigen vector analysis is a classical way of discriminating pollutants (Philpot and Klemas 1979). Industrial wastewaters like pulp and paper effluent discharges, can be spotted using a Fraun-Hopper line discriminator. The discriminator picks up the luminescent or fluorescent constituents like lignin to detect discharges (Watson et al. 1975). Pollutants can also be identified by sensing in the Thermal IR. Clean water has a typical emission pattern in the Thermal IR which closely follows black body radiation at that temperature. By performing a multispectral analysis in the Thermal IR region and plotting the deviation from the normal, the pollutants can be detected.

CASE STUDY

Songkhla lake is one of the largest in Asia covering an area of about 1000 sq. km. It is located at 100° 15' E and 7° 20 N. It is connected by a narrow channel to the Gulf of Thailand. The upper reaches of the lake are fresh and the water is used for irrigation. Farming, fishing and charcoal making are the three main occupations of the people living in the area.

LANDSAT images of March 1976, May 1982, Sept. 1982, and Nov. 1982 covering the lake area were used for the purposes of this study. The problem with using Landsat data especially, inthe tropical regions is that, many of the images are rendered useless by cloud cover. These particular images were chosen because of the minimal amount of cloud cover in them and the availability of coincidental water quality data for these dates. The software package used for digital data analysis was DIMAPS AR operating on an IBM 3083 computer.

Reflectance values in Bands 4, 5, 6 and 7 were obtained at selected places on the lake. These values were then correlated to the water quality data at those places. It was found that Band 5 reflectance vlues correlated well with turbidity (r= 0.825). At higher values of turbidity (about 50 NTU) an exponential equation fitted the data better. Further, water quality parmeters were correlated amongst themselves. There appeared to be no relation between turbidity and total PO content of the water.

The poor correlation between turbidity and total PO indicate that the suspended particles causing turbidity are mainly inorganic in nature and not algal matter. In such a case, a study of the sediment load of the lake might give a good estimate of the erosion of the soil in the drainage basin of the lake. It has been hypothesised that clear cutting of forests for making charcoal has adversely affected the quality of the lake water. It is proposed to study the impact of such changes in the land use pattern in the catchment area to water quality of the lake.

LIMITATIONS

Remote sensing is not a cure-all and suffers from several serious defects.

1. A number of water quality parameters which do not affect the optical properties of the water column still must be analysed by standard methods.
2. Investigations for the water quality are, with few exceptions, valid only for the top few metres.
3. In the measurement of suspended solids, calibration of reflectance values is based only on the intensity of light scattered by the suspended sediments present in the water column. Scattering becomes more and more predominant as particle size decreases. So the same value of radiance measured in the imagery could be due to a few mg/1 of fine silt or a few g/1 of coarse sand.
4. Resolution of satellite imagery is usually too poor for identifying effluent discharges or ocean dumping, unless it is on a large scale. LANDSAT has a resolution of 79 m in the visible regions. Thermal IR imagery usually has a resolution of only about one km. This problem will be alleviated to a great extent when imageries of LANDST-D Thematic Mapper, with a resolution of 30 m, and SPOT data with a resolution of 10 m become available.
5. Though any one point on earth is covered by LANDSAT once every 18 days, a large number of these images are not usable because they are obscured by clouds.
6. It is essential to note that even when remote sensing is used, one cannot completely do away with proximal sensing (conventional analysis). It is very difficult to quantify the variations in the radiance values occurring due to solar angle, atmospheric conditions etc. So it becomes necessary to collect ground data from a few sampling points to check, correlate, and apply corrctions to the satellite imagery.

In spite of these limitations, we recognize that remote sensing is a very powerful tool to assess water quality. Remote Sensing should be used to complement existing traditional methods so as to improve the efficiency of monitoring and managing the natural resources, rather than as a replacement of conventional methods.

SUGGESTIONS

One of the most important problems in applying remote sensing for water quality monitoring is the necessity of effectively relating images obtained on different dates. Varying atmospheric conditions causes the reflectance values of the same feature to vary significantly. Continuing research needs to be conducted to quantify the atmospheric attenuation for a given set of meteorologicl conditions.

An additional area for research is to obtain an estimate of the particle size distribution in the determination of suspended solids concentration in the water body.

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EXTENT AND SOURCE OF AQUATIC POLLUTION IN THE BRAHMAPUTRA DRAINAGE OF ASSAM

Y.S. Yadava*

INTRODUCTION

Man*s environment includes the air he breathes and the water he drinks. These are continually polluted by rapid growth of human population, expanding technology and consumption of natural resources causing serious imbalances of the environment. Water, a major natural resource with great potential and provision for supporting human life has been the main target of contamination posing serious problem, both from the public health and fisheries point of view. Industrial wastes containing highly toxic, organic and inorganic substances like acids, alkalies, dye, oil, detergents, compounds of arsenic, chromium, sulphur, zinc, lead, vanadium, hydrocarbon, chlorinated hydrocarbon, cyanides, phenol, free chlorine, free ammonia, mercaptans, hydrogen sulphide, biocides and even some radioactive materials find their way along with the discharge of trade wastes and have deleterious effects on fish and fih food organisms. The extent of pollution in the majaor River systems and estuaries of India except River Brahmaputra has been recognised and thoroughly investigated by many workers, the prominent being Seth and Bhaskaran (1950), Ganapati and Chacko (1951), David (1956), Qasim and Siddiqi (1960), George et al. (1961), Basu (1965), Bhaskaran et al. (1965), Gopalakrishnan et al. (1970), Ghosh et al. (1973), Pawar et al. (1979), etc.

The pollution of water in the North-East region although not yet fully assessed is quite obvious lately from the different observations and on scientific assessment. The mighty Brahamputra after criss-crossing the boundless tracts of the Himalayas enters Assam near Sadiya town and traverses about 640 km through the state before entering Bangladesh near Dhubri. The Brahamputra valley is bordered on all the three sides by foothhills of the Himalayas, the Patkai ranges and the Meghalaya plateau. A good number of tributaries fingering from north as well as south of the Brahmaputra feed the main channel. Notable tributaries from the North are Subansiri, Bharali, Pagladiya, Chalkhowa, Manas, Aie, Champamati, Saralbhanga and Sankosh. Of the tributaries emanating from the South, the important ones are Noa, Buridihing, Disang, Dikhow, Jhanzi, Dhansiri, Kopili and Digaru. The river system, besides providing navigational facilities, plays a vital role in sustaining the variegated life and fauna and flora of the valley and its surroundings.

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EXTENT AND SOURCES OF AQUATIC POLLUTION

The industrial pollution problem in the Brahamputra valley can be divided into mainly four groups.

1. Petroleum Refineries
2. Pulp and Paper Mills
3. Fertilizer Plants
4. Other minor industries.

Some observations on the water pollution by the Public Health Laboratory, Govt. of Assam, are presented in Table 1. The observations were taken during 1982. The details of important industrial units, their location, important pollutants in the effluents and any major fish kill reported are given in Table 2.

Petroleum Refineries

Increasing quantities of crude oils, petroleum derivatives, petroleum industry wastes and refined petroleum products are constantly added to the natural environment wihtout regard for ultimate diagnosis or its potentially adverse effect toward other organisms. Assam being an oil producing zone, extensive drilling and petroleum production operations are taking place in a wide area of the region. The extent of the pollution has never been assessed, yet it is reasonable to assume that the environmental effects of oil pollution could be more serious in this region than elsewhere in India. The effect may perhaps be more accentuated by the geographical features of this area where the drainagee is mainly through river Brahmaputra. The main pollutant from these Refineries are given below :

(a) Oil and grease, phenol, susp. solids, sulphides, mercaptans, acids and caustic in waste water.
(b) SO_2, H_2S and particulate matter in air emissions
(c) Sludge dumps and oil spillages on land.

The Digboi refinery which has been there since long before independence has been discharging its effluents wihtout treatment to the nearby river. The Bharaly rivulet (Gauhati) has been polluted by the effluents of the Noonmati Refinary with destruction of aquatic life. This rivulet in downstream contains oil as high as 32 ppm. Phenol content also varies from 1.0-1.4 ppm. Both these chemicals are beyond the tolerance limit for the stream (ISI, 1973). Due to depletion of oxygen (as low as 0.6 ppm) in water, and presence of oil, the self purification power of the river has decreased considerably showing thereby the accompanying effects, of offensive odour, darkening of water, floating of masses etc. Fish has almost disappeared from this rivulet. Similarly Assam Petro-chemicals Ltd., Namrup, pollute some of the other rivers which ultimately lead to the river Brahmaputra. It

Table 1. Ranges* of important chemical parameters.

Parameters		Brahmaputra Gauhati (Pandu)	Brahmaputra Dibrugarh
pH		7.3-8.1	6.8-8.1
B.O.D.	mg/l	0.4-3.4	0.8-8.5
C.O.D.	"	2.4-17.6	1.6-25.6
Total nitrogen as N	"	0.28-11.2	0.24-11.3
P. Alkalinity as $CaCO_3$	"	Nil	Nil
M. Alkalinity as $CaCO_3$	"	48.0-90.0	44.0-230.0
Total hardness as $CaCO_3$	"	48.0-104.0	46.0-200.0
Calcium as $CaCO_3$	"	28.0-61.0	40.0-156.0
Magnesium as $CaCO_3$	"	18.0-44.0	6.0-30.0
Sodium	"	4.0-16.0	1.3-9.0
Sulphate	"	4.0-21.0	2.0-19.0
Nitrate & Nitrite - N	"	Nil-0.4	Nil-0.2
Chloride	"	2.0-11.0	4.0-10.0
Colifom (MPN per 100 ml)		460-1,10,00	930-2,40,000
E. coli (MPN per 100 ml)		43-15,000	90-46,000

* The ranges are for the period Jan-Dec. 1982.

Source: Public Analyst, Govt. of Assam, Gauhati.

Table 2. Effects of Industrial Effluents on Fish in Brahmaputra

Important industries and their location	Reports of major fish kill
Indian Oil Corporation, Gauhati Refinery. Noonmati. Gauhati	Fish has disappeared from rivulet Bharalu.
Bongaigaon Refinery and Petro-chemicals Complex. Dhaligaon	No fish kill
Assam Oil Corporation, Digboi	No fish kill
Hindustan Fertilizer Corp. (India) Ltd., Namrup	Besides metallic pollution Frequent reports of fish kill. Fish yield has come down.
Assam Petrochemicals Ltd.. Namrup	Pollution controlled
Assam Co-operative Sugar Mills. Dergaon	Fish yield has come down in Gelabil river
Ahsok Paper Mills, Jogighopa (Nowgong)	Dhar Brahmaputra fish is reported to cause some stomach pain.
Chemical Unit of Associated Industries. Chandrapur Dist. Kamrup.	No fish kill
Yarn Dye House	Yet to be commissioned
Hindustan Paper Corpn. Jagiroad. Nowgong	Dorika river fish gives an oily smell.
O.N.G.C.. Eastern Region, Nazira	Fish kill in Jhanji river
Oil India Ltd., Dullajan	No fish kill

Source· Board for Prevention and Control of Pollution. Gauhati is interesting tonote that the Dubb s separator alone from the refinery of Assam Oil Company, Digboi, produces a maximum of and minimum of 111 and 16 kl effluents/hr with an average of 20 kl/hr. The gross pollution by petroleum is on increase and the situation unlikely to change due to digging ofmore and more wells for incrasing oil production from this area (Lonsane et al. 1977).

Pulp and Paper Mills

The region has two large and three smaller paper mills:

(a) Hindustan Paper Mills, Jogighopa,
(b) Ashok Paper Mills, Jagiroad,
(c) Nagaland Paper and Pulp Mill, Tuli,
(d) Kamrup Paper Mill, Gauhati, and
(e) Dhing Paper mill, Dhing.

These factories adopt the sulphate process for manufacture of pulp and paper. For this purpose the bamboo chips are cooked in the digester with a mixture of caustic soda, sodium sulphate, sodium sulphide and steam. The pulp and paper waste is highly alkaline containing cellulose fibre, calcium hypochlorite, methyl mercaptan, free chlorine, lignin and sizing materials such as resin, soap, alum, starch and silicate. B.O.D. values range between 490 to 785 mg/l. The Nagaland paper mill discharges its effluents into the Tipak nala and then ultimately to the river Brahmaputra while the other paper mills are directly poluting the river Brahmaputra. Discharge of large quantities of suspended solids result in high levels of turbidity and excessive sediment build-up which may turn the river bed unsuitable as spawning ground for fishes. The organic pollutants containing non-toxic materials of high oxygen demand may deplete the oxygen budget of the water body leading to asphyxiation and death of fish.

Fertilizer Plants

The state has one large Fertilizer Plant at Namrup and the efflunts are discharged into the Dilli river that flows into the river Disang and has been causing destruction of aquatic life and fishes in this river.

The breakthrough that is being achieved by the green revolution could not have been realised without the application of heavy doses of fertilizers. In Borlaug's words, "If the high yielding varieties of crops are vehicles, then the fertilizers are the fuel to such vehicles, which have revolutionised agricultural production in recent years". However due to indiscriminate use of nitrate and phosphate fertilizers in plenty, parts of these salts are not utilized by plants and eventually they end up in our rivers, lakes and estuaries leading to the deterioration of aquatic environment. This problem may not be that serious presently due to little or negligible use of fertilizers in the region, yet cannot be ignored due to the increasing stress on high yielding varieties and maximum use of fertilizers for enhancing per hectare production.

Other Minor Industries

Various other industries of smaller magnitude viz. Spun Silk Mill, Jagiroad; India Carbon and Assam Carbon, Gauhati; Diomapur Sugar Mill, Dimapur, Bokajan Cement Factory and Assam Hard Board Factor; Baruah Bamungaon Distillary, Jorhat; Distillaries of Bhutan, etc., are discharging their untrested effluents directly into the river Brahamputra or through its tributaries. D.D.T., a common pesticide, used widely in the region to combat mosquito menace is acause of concern to water pollution besides the pesticides and herbicides used in the Tea gardens also enter the water bodies from the run offs.

Leaving aside the industrial waste problem, the unplanned drainage/old sewage plants of the State along with the urban waste discharge, run off from the rural community cattle farming, etc., is also becoming the source of the bacteriological load ultimately to the Brahmaputra system.

The water pollution problem in N.E. region and particularly in the Brahmaputra drainage system is at present very low to assume a state of acute crisis, yet it is the hour to exercise due restraint and checks on the effluent discharge. Should the water quality be allowed to deteriorate beyond certain limits, the situation may go out of control and may adversely affect all uses water is put to, throwing the entire ecosystem out of gear and culminating in a severe biological imbalance.

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FUELWOOD FOR RURAL AREAS OF THE LESS DEVELOPED COUNTRIES

S. Mohammad Hassan Khandani*

OVERVIEW

The higher prices of oil since 1973 have left many LDCs with large balance of payment deficits and high cost of imported petroleum which have resulted in lower economic growth and. in some cases. have reversed economic development: some have had a decline in food production because of the lack of fuel for irrigation pumps and petroleum based fertilizers.

This situation has forced the poor in these countries to increase demand on less costly traditional energy sources. especially wood. Such increased demands have worsened the already existing environmental problems. such as deforestation. in many LDCs. In this paper different aspects of wood utilization, as a major energy source in the rural areas of most LDCs is discussed. The role of wood in the enrgy mix of LDCs. its fuel value and alternative uses. deforestation problem. land use and environmental protection. and wood plantation as a way of supplying this fuel for rural areas discussed.

Share of Wood in Energy Mix of LDCs

LDCs with more than 40% of the world s population consume about 10% of the world's commercial energy. On a per capita basis. commercial energy consumption of LDCs is less than 4% of that in the United States. However. LDCs consume a large amount of non-commercial energy in the form of fuelwood. crop residue. and animal dung. The ratio of non-commercial to commercial energy consumption of LDCs is more than 0.9. On an individual country basis. this number is much higher: e.g. between 7-9 for India and 4-8 for Ethiopia.

About 40% of the world s wood production is consumed as fuel in the developing world. according to the Food and Agriculture Organization. In some tropical countries like Malawi. Nepal. Tanzania. and Uganda fuel wood constitutes over 90% of their total energy budget: and in China which harbors about one third of the human race. wood is the main energy resource. In rural areas it is consumed domestically for cooking. heating. and lighting. Cooking represents about 50% of the fuel use in many areas. and perhaps up to 80% in the warmer regions.

Furthermore. non-commercial energy in LDCs is used with a very low efficiency of about 5% as compared to 20% for commercial energy. The result of this inefficiency is an increasing shortage of such fuels in general and fuel wood in particular. This shortage has an immediate impact on the life of a large portion of the population that lives in villages and rely upon wood as their primary fuel for cooking and heating.

These figures should be taken as an indicator of the role of wood as an energy resource, and not as an accurate tally because very few countries in the developing world have reliable statistics about their non-commercial energy sectors. This might be one of the reasons behind the fact that most global studies have failed to address the question of noncommercial energy resources.

Fuel Value of Wood and Charcoal Production

The approximate proportions. by weight, of the main elements present in wood are: carbon 50%, hydrogen 6%, oxygen 43%, and a trace of nitrogen. The presence of oxygen in wood lessens its value as a fuel. Thus coal (bituminous), which is almost oxygen free, has a heating value of about 6.9 kcal/g. whereas air-dried wood (20-30% moisture content) has a heating value of 3.7 kcal/g and oven-dried wood averages 4.7 kcal/g. Moisture is the most important controlable factor influencing wood efficiency. The reduction of wood moisture is necessary for two main reasons: to reduce its weight and to increase its fuel value. Wood is usually cut three to four months before use in the tropics, and six to twelve months in the temperate zones, in order to reduce the moisture content to about 20 to 30%.

In India, for example. annual fuel use with open slow-burning fires is about 1.2 to 1.8 million kcal (5 to 7 million BTU) per capita, whereas in the United States, where family size is even smaller than in India, the annual per capita use is about 3 million BTU for electric stores, including waste heat at the power plant. Obviously, the reason for this is the low efficiency of the stoves used in India. Research to produce inexpensive efficient cookers would help save some of this wasted energy, which could then be utilized for other purposes.

Most charcoal is made from wood, although other materials like bones and coconut shells can be used to produce charcoal. Wood is converted into charcoal by a process of carbonization. The heating value of charcoal is 7.1 kcal/g compared with 3.7 kcal/g for air dried wood. But conversion still results in a decrease in the total energy yield since all the necessary energy is provided from the combustion of part of the wood charge. On the other hand, charcoal has more desirable properties than wood; it is smokeless, almost sulfur free, and can be used in stoves capable of heating the home as well as adaptable for cooking. Charcoal is also used in water purification, an urgent need in many villages of the Third World.

Charcoal may be produced by simple pit methods requiring no capital. Charcoal s value may be increased by briquetting, i.e. powdering the charcoal and mixing it with charcoal fines, wood and tar or starch to form briquettes. It may be valuable therefore in dealing with the transportation problem in the LDCs by providing good fuel for producer-gas units. Briquetting, however, is a capital intensive operation; it does not lend itself readily totherural areas unless small hand operatedbriquetting machines are developed. Charcoal will not be considered, however, in this paper when wood plantations are under discussion.

Distillation and Other Uses of Wood

In distillation, wood is heated in a closed container that permits all gases and liquids to pass out through a condenser. The non-condensable gases can be utilized as an energys ource, and the condensed gas and water-soluble tar collected, from whence they can be decanted and fractionally distilled to give useful chemical products. Such products include: gas, methyl alcohol, acetic acid, acetone, wood oil, light tar and pitch.

Wood distillation is an age-old practice; it is believed that the ancient Egyptians recovered tar and pyroligneous acid from wood and used it to embalm their royal dead. In the United States and Europe it was used until the products of wood distillation were synthesized less expensively from petrochemicals. It is clear that wood distillation is not a high priority in the rural areas because of the technical sophistication it needs. But it has potential in the long run. The same can be said for gasification.

Although it is not the main subject of this paper, a brief look at the uses of wood other than as an energy resource may be of some relevance. The list of uses to which wood and its extractions, can be put is impressive. As a material for industry wood is used in the production of pulp and paper, firewood, particle board, handles for agricultural implements and sporting goods, furniture, pencil slats, and briar wood pipe and match blocks. Some of these lend themselves to small scale and labour-intensive industries. Particle board, furniture and agricultural implements are but a few examples.

As noted above, chemical treatment of wood yields a large variety of products, most importantly, charcoal and methzl or wood alcohol, which can be used in a number of important industries such as steel manufacturing, water purification and tobacco curing. These uses of wood make it a subject of attention; they compete, however, with its use as an energy resource. It is necessary, when considering the utilization of wood as a fuel resource, to study whether a village sight be better off by putting it to industrial use.

Deforestation

In the natural forest, except in times of epidemic losses due to disease or insects, the mortality losses balance the accumulation of annual increments, and the net result of the dynamic change within the forest is little or no change in total volume of standing trees. In other words, the natural forest, if left alone, remains in dynamic equilibrium: it balances the energy gains against the energy losses.

This dynamic equilibrium is threatened today more than ever before. Early man considered the forest his habitat andthe situation in Africa, Asia and Latin America today, show that for many tribes and peasant communities the forest represents their chief source of life, they fell its wood for fuel, graze their animals there, hunt its fauna for subsistence, and clear it to grow other food products. But with the growth in population and the unplanned use of the forest, deforestation and the spread of the desert are becoming already a major problem in these continents.

Eckholm states that "the spread of the Sahara has probably been measured most preciselgy in Sudan. There, as elsewhere, vegetational zones are shifting southward as result of overgrazing, woodcutting and accelerated soil erosion". The example of Khartoum, the capital city of Sudan, is illustrative: "dense concentrations of the acacia tree were common around the Sudanese capital of Khatoum as recently as 1955, but by 1972 the nearest dense acacia stand stood 90 km south of the city."

The encroachment of the desert is not limited to Sudan, it is a major problem in parts of southern Africa, Kenya, Tanzania, Ethiopia, Brazil, Chile, Nepal, Thailand, Philippines, and China among others. In Brazil, desert-like zones are expanding in the more humid interior protions of the northeast as a result of massive destruction of forests by ranching corporations and land-hungry farmers. In the Coquiabo region of Chile, the inequable land tenure pattern premotes ecologically unsound land use. The large and sparcely populated estates of the wealthy have room for proper grazing rotations, while the inadequate communal personal holdings of the poor majority are overcrowded. In Gambia in many sampled villages, the people complained that wood fuel was more and more difficult to obtain. Collectors have to set off at mid-day in order to collect and be back for night-fall; where is previously the woodfuel could be found just outside the door. Thus while in the United States and Europe the cutting of forests helped development, in the LDCs the forests are lost and little development is achieved.

Wood Plantations

The need for rural development, the role that wood plays in providing energy and raw materialm for industry in these areas, and the rapid deforestation, make it imperative that steps are taken to insure that something be done about the situation. Two methods are practiced: (1) refining and enrichment of the natural forest, and (2) wood plantations. These two methods are not mutually exclusive and they can complement each other. In this paper, however, we limit the discussion to wood plantations, particulrly for rural areas.

Planting forest trees it unforested areas or within cut-over areas in the natural forest has long been a recognised technique. A figure of 4.375,000 ha of quick growing plantations in latin America, Asia Pacific, the Near East and Africa is reported. Fast growing plantations are defined as those capable of a mean annual increment of at least 7 tons per hectare under favourable site conditions, provided that appropriate techniques are used for ground preparation and for the establishment, cure, and tending of the plantations. The definition seems reasonable since in the natural forest, in the absence of intensive silvicultural treatment, the annual mean increment is less than two tons/ha. Mean annual increments of more than 55 tons/ha have been reported in some eucalyptus fuelwood plantations over rotations of 6-8 years in Africa. A 15 ton/ha/year might be more representtive in tropical regions.

The two main groups of species which are usually recommended are eucalypts and confiers. Advance have been made in species choice and testing, and in site selection. Knowledge has also increased in the field of control of pests and diseases. The beneficial effects of tending such as weeding, thinning, and pruning have become better appreciated.

As example of a successful project in India is also presented. A blast furnace industry with an output of 80 tons of iron per day, together with a ferro-silicon plant, is supplied with 40,000 tons of charcoal per annum from the surrounding forest. Approximately 3200 to 4000 hectares of lightly exploited, low value forest is cleared annually for conversion to plantation. The forest department which orgnizes and administers the whole pocess, receives a royalty of $3.75 per ton.

Economics

Various estimates have been given as to the cost of obtaining woodfuel from wood plantations. Relying on Openshaw s estimates, Makhijani states that capital cost of establishing village woodlots (wood plantations) to supply fuel wood-excluding land costs and the cost of local labour would be about $20/ha. The money would be spen primarily to provde suitable plant varieties and to train villagers to operate the plantation: the investment would be in local currency. With the cost of labour included, the costs run up to $200/ha. Each hectare would have an anmnual yield of about 25 tons of wood. If the rotation is ten years, and the price of the wood is $5/ton ($0.40 per million Btu), then the annual output per hectare would be worth $75. At a discount rate of 10% the present worth of all the wood that will be produced from that scheme is about $300, the present worth of the capital invested in $120, assuming that $200 is invested in equal instalments of $40 over the first five years.

The cost estimate for establishing and maintining an eucalyptus plantation in Uganda at 10% discount rate for 5 and 6 year rotations is $300 and $385, respectively, assuming a worker s wage of $72 per day. Agricultural crops such as groundnuts, grown between the trees during the first year of the plantation s life would cut the costs down to $125 and $190 per hectare for the same rotation periods. These costs have to be compared of course, with the costs of alternative sources and the opportunity costs of using the trees for other purposes. Certainly these costs are much lower than those for oil and electricity.

The relatively low costs are obtained by the worker s low wage, the fast growth rate, and the uniform nature of the crop. If wood is to be transported for use in areas far from the plantations, then the transportation costs must be added; these become most critical. Since the carriage is charged by weight, not by volume, it becomes essential that wood be dried before it is shipped. Another cost item is storage: unless fuelwood is well dried out, its comparatively low calorific value may lead to abnormally high storage costs. In the case of village woodlots, trnsportation and storage costs can be omitted.

Land availability and Environmental Protection

Land availabiity for wood plantations is an essential requirement. Where it is available, it is reasonable to omit the land cost from the estimates of capital cost. But where both land and fuel are scarce, the calculation becomes more difficult. In Bangladesh, a striking example of the scrcity of both fuel and land, it is necessary to increase the productivity of agricultural land sothat some of it may be allocated for wood lots. In some places, like China, where there is a reforestation program, the introduction of wood lots with a faster and bigger yield may, in the opinion of some analysis, release some land for agricultural purposes. Wood plantations may also aid agriculture in other ways by preventing wind and water soil erosion, and by providing the wood fuel requirements of the rural commities, thus making animal dung available as fertilizer.

The required land area will depend on the site of the community which it serves, the consumption rate, and the increment of the wood plantation. If villages are not sparcely distributed, they might find it more economical to have a communal lot.

The natural forests also provide habitat for wildlife which is vital in and of itself. If they were replaced by plantations this form of life would by threatened. The species cultivted today are also not necessarily the only ones which will be useful to humans in the future. Moreover, there is reason to worry that potentially valuable strains may be eliminated with consequent loss to the gene bank. These are important considerations that a country must examine if it undertakes a wood plantation program. Such issues used to, and are still, considered by some to be "externalities", they must be internalized since future generations will have to pay the consequences. Besides it is impossible to put a price-tag on the extinction of wildlife. If the program is limited to village wood lots, however, this would not be a serious problem.

Administering the Woood Plantation

Admnistering the village wood lot requires special care. There will always be a temptation to cut the trees prematurely before the stand is established, or to overcut once it is. If there are poor in the village, they may cut the wood for sale. The task of administering the woodlot is perhaps a good example of how the energy issue is linked to other policies. Equitable distribution of wealth, and education of the villagers as to the value of the woodlot for all are essential. Cooperation then can be anticipated, the villagers tend to be willing to participate in schemes to estabish woodfuel plantations provided they learn the basic skills. Policing the woodlot is not an effective method in the long-term, and in addition, it is a costly operation.

The administration will include, of course, other operations like weeding, thinning, pruning, fertilizer application, and harvesting. All of these are labour-intensive operations and have to be well timed and organized in order to avoid peak labor shortages which are common in rural areas.

Protection of the woodlot from pests, diseases and fires are also necessary. The spread of an epidemic or the burning of a woodlot could deal a serious blow to the village energy resource. This is, perhaps, one of the bigest problems which must be taken into account. If the wood lot is damaged there must be provisions to insure that the affected village continues to receive a fuel supply.

Social Benefits

Wood plantations are labour-intensive technologies, a characteristic which makes them suitable for many rural areas where is a problem of un- and under-employment. The employment of these people in useful work must be cosidered an and in itself. It also generally leads to a healthier life in the whole village, and slows migration to the already crowded slums of urban centers. The energy that many people expend now in fetching their wood could be utilized in other forms of useful labour, or in "leisure time". This, of course, is not unique to woodlots, but is an advantage shared by other energy resource which would relieve this burden.

Self-reliance, the conservation of depletable fuels, and the creation of a dynamic rural environment are the final important considerations.

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MANAGEMENT AND PROFITABLE USE OF FOREST RESOURCES OF MORNI HILLS

S.R. Gupta and S.K. Rout*

INTRODUCTION

The forests of Morni Hills represent an ecologically important natural habitat in north-eastern region of Haryana. The forests cover an area of 2069.2 hectares and are comprised of *Pinus roxburghii* forest, mixed deciduous forest, *Dendrocalamus strictus* and Scrub forest. The forests play a vital role in maintaining ecological balance in this region of unstable Shiwaliks and influence to a large extent the socio-economic condition of local population. The forests are a source of timber, fuelwood and charcoal, medicinal plants and a number of industrial raw materials. In view of the geological and physical characteristics of the terrain, the forest resources are to be managed properly for their profitable extraction. This paper discusses the forest resources of Morni Hills from the point of view of their protective role, maintenance, improvement and maximum production.

DESCRIPTION OF AREA

Morni Hills are located in north-eastern region of Ambala district in Haryana. The area lies between 30° 35' N and 75° 15'E at an elevation ranging from 365 m to 1499 m above mean sea level. Morni hills are characterised by highly dissected land topography. In the south, the hills are rugged with deep vertical cuts forming ravines at many places, and the hills merge with outermost Himalayas in the north. The northern part of the area drains into Ghaggar flowing through the tract. The southern part drains into Tangri and Markanda streams which ultimately join Ghaggar river.

The tract is hilly and represents tertiary Shiwalik formation. Underlying rocks are soft sandstone and conglomerates. Upper strata are composed of sandy loam and hard clay layers. At places, round boulders occur in the subsoil.

Climate of the area is subtropical and monsoonal. Rainfall varies from 1000 to 1500 mm per year. A major portion of rainfall occurs during July to September from summer monsoons. Some rainfall also occurs in winter months.

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FOREST TYPES

The total area of Morni hills is 24280.53 ha of which 20692.16 ha is forest and wasteland. and 3588.37 ha is under cultivation.

The differences in altitude. aspect and other locality factors give rise to form distinct types of forests. viz., Pinus roxburghii forest. Dendrocalamus strictus, mixed deciduous forest and Scrub forest. A brief account of various forest types is as follows:

Pinus roxburghii Forest

Pinus roxburghii forest occursin northern part of the tract and is confined to cooler aspect. The trees are middle aged and young poles have subnormal density. Natural regeneration is poor or absent. The areas of poor density are characterized by abundant shrub growth.

Bamboo Forest

The forest of Dendrocalamus strictus occurs over a limited areain east and found mixed with species like Acacia catechu. Lannea coromandelica and Cassia fistula. Due to extensive exploitation, the forest stands are in deteriorated condition.

Mixed Deciduous Forest

The miscellaneous forest occurs in northern part of the tract and is mainly composed of Anogeissus latifolia, Acacia catechu, Bauhinia variegata, Cedrela toona, Emblica officinalis, Grewia oppositifolia, Garuga pinnata, Lagerstoemia parviflora, Lannea coromandelica, Mallotus philippinensis, Terminalia chebula Terminalia tomentosa, Holoptelia integrifolia, Kydia calcina, Mangifera indica. Occasional trees of Pinus roxburghii are also met with. Undergrowth consists of several shrubs and grasses. Climbers are also common.

Scrub Forest

The scrub forest is confined mostly in the south. Degradation is maximum in these forests particularly in the foothills where a major part of the hills is reduced to ravines on account of adverse biotic factors. In the interiors, the vegetation cover is in improved condition. Main species are: Acacia catechu, Acacia nilotica. Acacia leucophloea, Dalbergia sissoo, Zizyphus mauritiana. Shrubs like Adhatoda vasica, Carissa spinarum, Rhus parviflora, Euphorbia royleana, Lantana camara, Nyctanthes arbor-tristis and Flacourtia indica are common.

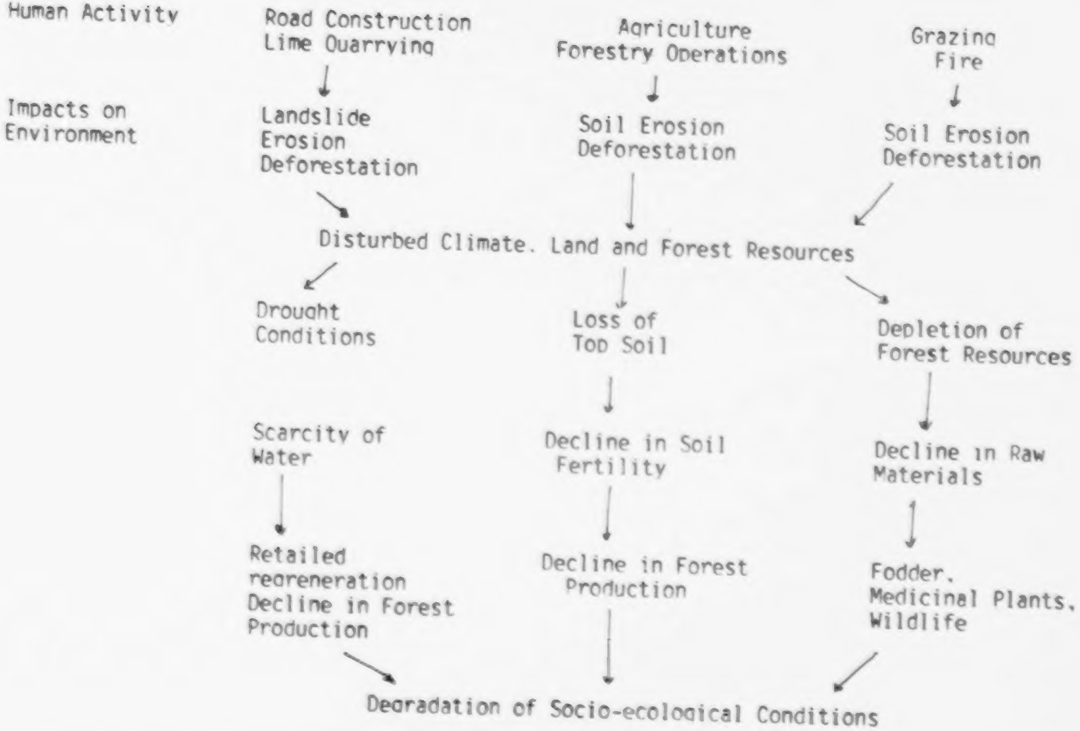
Human Activity
Road Construction
Lime Quarrying
Agriculture
Forestry Operations
Grazing
Fire
Impacts on
Environment
Landslide
Erosion
Deforestation
Soil Erosion
Deforestation
Soil Erosion
Deforestation
Disturbed Climate. Land and Forest Resources
Drought
Conditions
Loss of
Top Soil
Depletion of
Forest Resources
Scarcity of
Water
Decline in Soil
Fertility
Decline in Raw
Materials
Retailed
regeneration
Decline in Forest
Production
Decline in Forest
Production
Fodder.
Medicinal Plants.
Wildlife
Degradation of Socio-ecological Conditions

Fig. 1. Impact of human activity on forest resources of Morni Hills

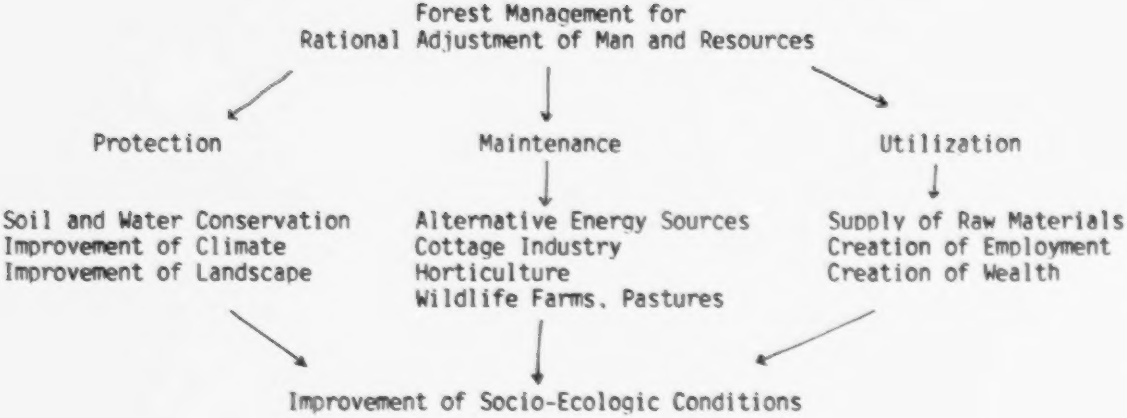
Forest Management for
Rational Adjustment of Man and Resources
Protection
Maintenance
Utilization
Soil and Water Conservation
Improvement of Climate
Improvement of Landscape
Alternative Energy Sources
Cottage Industry
Horticulture
Wildlife Farms, Pastures
Supply of Raw Materials
Creation of Employment
Creation of Wealth
Improvement of Socio-Ecologic Conditions

Fig. 2. Forest Management in Morni Hills

FOREST PRODUCTS

The main marketable forest products include timber, fuelwood and charcoal, katha, resin, jhingam gum, bhabhar grass, bamboos, *Terminalia chebula*, fruit and flowers of *Viola serpens*. Chil timber is extracted to a limited extent as felling is strictly prohibited in chil forests. Fuelwood is sold from areas conveniently approachable. Fuelwood is converted into charcoal in the interior areas which are not accessible. Katha is extracted from the trees of *Acacia catechu* when sold from the tract. Resin is extracted from *Pinus roxburghii* and the trees are sold for tapping annually. Jhingam gum is obtained from *Lannea coromandelica* trees found mixed in dry deciduous forests. Bhabar grass is extracted from outer Shiwaliks.

MANAGEMENT OF FOREST RESOURCES

Morni hills with their own peculiar environment, social and economic problems call for an environment oriented planning. The impact of man s activity on forest resources is summarised in Figure 1. Keeping in view various socio-ecological problems of the area, the forest resources are to be managed properly for the over all development of the area and for improving the Socio-economic condition of local people. The forest resources are managed both for protection and utilization (Puri et al. 1983). Protection is a sensible management concept for improving vegetation cover over badly eroded hills and for achieving normal forest growth. From the point of view of utilization, production capacity of forests must be improved for ensuring progressive yield of pulpwood, katha, resin, bamboo, bhabar grass, firewood and timber. Some important features of forest management in Morni hills are presented in Fig. 2. Various aspects of forest management are discussed below.

Protection of Forest Resources

Grazing and agriculture are the two most important occupations of village population. There has been harmful effect of indiscriminate grazing on forests and natural regeneration of trees. Trees are extensively lopped for grazing during winter and summer. The scrub forest is in highly degraded stage due to heavy biotic pressure, perennial grasses have disappeared giving place to weeds like *Lantana camara* and *Euphorbia royleana*. Agriculture has increased the risk of soil erosion on slopes not suited for growth of crops. A major part of the forest area is characterised bypoor site conditions. The slopes are steep and fertility status of the soil is low. The fires cause deterioration of vegetation and soil, hamper progresseive ecological succession. Keeping in view the problem of forest management for protection, following measures have been suggested.

Control of Grazing

Complete ban on grazing in areas of poor vegetation and scanty regeneration, and control of grazing in Pinus roxburghii forest may improve natural regeneration and establishment of seedlings. Planting areas of bamboo must be closed for the improved growth of bamboo. In outer Siwaliks, grazing should be stopped in whole of the areas because the hills are in advanced stage of erosion. Sufficient land should be allotted to provide green fodder to animals. Some forest areas should be planted with fodder trees. There should be reduction in cattle number, improvement of their breed and stall feeding as has been suggested by Gupta (1980a) while discussing potential for increased forest production in sub montane region of western Himalayas.

Control of Tree Felling

There should be no felling of trees in scrub forests to control soil and water erosion and improvement of vegetation growth. Felling for timber and fuelwood in various forests should be practised keeping in view site conditions, tree maturity and tree density.

Improvement of Vegetation Cover

There should be extensive planting of economically important species like Acacia catechu, Dalbergia sissoo, Acacia nilotica, Anogeissus latifolia, Cedrela toona and Grewia oppositifolia. The area under fuel producing trees should be increased to meet the local demands.

Control of Fire

The forests are to be protected from fires by creating firelines.

Maintenance of Forest Resources

For the substained growth of forest, the resources are to be maintained by developing alternative sources of employment and income generation. There is imperative need for developing alternative sources of energy also. Some important points to achieve this objective are:

Cultivation of Wild Fruit Trees and Medicinal Plants: The cultivation of wild fruits must be encouraged for meeting local requirements after assessing their productivity and food value. The cultivation of medicinal plants can also prove useful. The plants that can be grown for edible fruits and medicines are: Aegle marmelos, Emblica officinalis, Berberis lycium, Mangifera indica, Morus alba, Tamarindus indica, Syzygium cumini and Pyrus pashia. Gupta (1977, 1980) has listed important medicinal plant components of Indian forests and also described the medicinal plants of Siwalik hills. The scope of wild fruits in agro-forestry was discussed by Sharma (1983) emphasizing their high fruit yield, adaptation to poor soils and drought conditions resistance to diseases and pests and quick growth. The trees of wild fruits can also produce timber of good quality and foliage of fodder value (Sharma 1983).

Introduction of Horticulture: Horticulture should be introduced in areas based on site suitability and relationship between weather pattern and fruit yield. Fruit trees can better conserve soil and water compared to agriculture. Interculture operation in agriculture with fruit plants and off-season vegetable can be used. This would also provide occupation to local population.

Village Industries: The existing forest resources can be utilized to promote forest based village industries. Among small scale village industry, poultry farming, bee-keeping, spinning and weaving and charcoal making can be can be encouraged. Gupta (1964, 1980) has discussed the economic plants for small-scale industry and emphasized its need for rural development.

Breeding Farm for Wildlife: Establishment of wild-life breeding farms can protect wildlife and create a quantum of employment.

Utilization of Forest Resourcs

The management plan for the utilization of forest resources has been prepared by the forest department. The objective of managing the forests for utilization is to maintain the supply of raw materials, creation of employment and raising the socio-economic status of local population. To meet these objectives, efforts are underway to properly manage the forest resources. Different working circles of the forests have been demarcated. It has been recommended to prepare volume tables of trees for felling and to undertake felling for timber and fuel wood in prescribed forest compartments. For the extraction of resin from Pinus roxburghii, jhingam gum from Lannea coromandelica and preparation of charcoal, specific rules have been formulated. The extraction of resin and gum is permitted from mature trees without causing any injury to the trees. Charcoal is prepared only in interior felled areas of mature crop of trees.

Plantations are being raised in clear felled areas and in areas of poor density. The species used for plantations are: Pinus roxburghii, Pinus caribbea, Pinus petula, Acacia catechu, Anogeissus latifolia, Terminalia tomentosa and Dendrocalamus strictus.

RESEARCH AND MONITORING

The management efforts must be backed with a strong component of research. Baseline data must be collected on abiotic and biotic components of the area, land use practices and the socio-economic survey regarding the local population. It is essential to generate information on climatic variables, soil and vegetation characteristics, productivity, population dynamics, pattern of human utilization of wild plants for food, fodder, drugs and construction of shelter.

ENVIRONMENTAL AWARENESS

Local population must be associated as far as possible with protection and preservation of forests, and change in landuse patterns. The key process of management lies in educating the local population about the value and benefits of forest conservation. It is required to develop favourable perception and new attitudes towards conserving the forests by creating a general awareness among people. The education and training programme is needed both for public and for those persons who are involved in management and extraction of forest resources. Broad (1969) suggested environmental education as an important aspect of conservation management for solving the vast problems of biological resources. For making education meaningful, suitable information material must be developed for describing the general feature of the area, improved land-use practices, restoration zones, socio-economic aspects of life of local people through documentary films, public meetings, training camps and setting up of small museums.

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SHIFTING CULTIVATION: ECOLOGICAL IMPLICATIONS

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INTRODUCTION

"Shifting. jhum or Podu Cultivation" is an agricultural practice prevalent in tropical countries. In this practice a forest patch is cleared to raise agricultural crops for one or two years only and then shifted to another patch. The practice. according to some studies is viewed as destructive due to loss of vegetal cover. soil nutrients. etc. but it is tagged to tribal econom and therefore. deserves to be rationalized. The Task Force made a thorough study and threw some suggestions in this regard. In this paper it is suggested to provide infrastructure facility and financial help to shifting cultivators to grow agricultural or cash crops either over ravaged hills or over the lands that might be alloted to them for permanent agriculture.

THE PRACTICE AND ITS HISTORY

Shifiting cultivation or shifting slash and burn farming is an agricultural practice prevalent in tropical countries. It is traced back to historical ages. Some 12.000 years ago the neolithic man shifted from food collecting to food producing. developing an agriculture and clearing land (Bates 1961). During this time. he discovered that seeds of certain grasses could be eaten. To obtain these easily. he tried to grow them close to his abode. The early English settlers in Virginia in the 17th century adopted the shifting agriculture already practiced by the Indians. Shifting agricultural practice was still in use in the middle of 19th centruy (Nye and Green-land 1960). Such practice was carried on around Mediterranean Basin for prehistoric millennia and for some centuries before the Spanish conquest in central Chile (Aschmann 1977). The Cultivator selected a piece of virgin forest land. cut down the trees and bushes. sowed the seeds mostly of millets. pulses. curcurbits. etc.. in drills made with stick without using plough or animal. Such virgin lands gave crops for one or two years and thereafter the crop production started declining because of dual reasons: one. the progressive degradation of naturally available fertility of virgin soil. and the other. soil erosion. He abandoned the land after one or two years of cultivation and then moved toa new patch and repeated the process. After certain duration of fallow period. the abandoned

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**Dept of Botany, Berhampur University, Berhampur, India* land rehabilitated itself with regrown vegetation and became available for facing a similar onslaught all over again. Here the farmer instead of changing the crops over the same plot changed the plot or shifted himself to another plot to grow the same crop or shifted the cultivation thus known as shifting cultivation.

As years rolled by, people who lived in the river valleys, resorted to settled or permanent agriculture and adopted moder practices whereas isolated communities living in the remote areas contained shifting cultivation. Therefore, the shifting cultivation is viewed as a transitional stage in the evolution of modern land husbandry practices. At present in India, this practice is largely confined to the tribal communities.

In settled agriculture the farmer maintains the fertility of the soil by adding manure and fertiliser from time to time but in case of shifting cultivation the poor tribal farmer has no money for these energy subsidies, the burnt out ash of the slashed vegetation is the only source of nutrition or energy subsidy for him.

Shifting cultivation is a global phenomenon, particularly an Asian one. It is known as caingin in Phillipines, Humahin Java, Ladang in the East Indies and Malaya, taungya in Burma, tamarai in Thailand and ray in Indochina. In Chile it goes by the name curben. In India it is significantly practised in the North Eastern region comprising the states of Assam, Meghalaya, Nagaland, Manipur, Tripura and Union Territories of Arunachal Pradesh and Mizoram. The practice is also prevalent in Andhra Pradesh and Orissa and to a lesser extent in Bihar, Madhya Pradesh, Kerala, Karnataka, Maharashtra and Sikkim. The practice is locally known as jhum in North Eastern Region, podu in Andhra Pradesh, bewar or dahza in Madhya Pradesh. In Orissa it is known as dahi (firing), kaman (saving) and taila (upland) among the Juang of the Keonjhar hills, as biringa or kaman among the Paudi Bhutiza or Bonai subdivision and Bhuinya pirch of Keonjhar District, as bagada, barun or mulei among Seoras and Mahalis of Ganjam District, as haren by the Dongria Khond of Koraput District, as rama by the Desia Khond of Rairakhol and Bamra Sub-Division and as livang or kunda chase by the Bonda of Koraput District. In some places of South Orissa it is also known as podu, gudia, donger or chas.

In this destructive process, the character of vegetation undergoes a drastic change. The regression proceeds a pace and the forest of high trees given place to low vegetal cover such as bamboo and shrubs (Chaturvedi and Uppal 1960).

THE TASK FORCE

The Government of India constituted a Task Force on shifting cultivation. The Force prepared a report in October, 1983 which will provide a basis for the Government to lauch an action programme and curb shifting cultivation as an agricultural practice for it has an adverse impact on forest conservation, ecology and environment. An assessment made by the above Task Force reveals that in India about 9.942 sq.km area is under shifting cultivation every year involving 622.236 families. Orissa State accounts for largest area in the country with 5,298 sq.km annually under shifting cultivation involving 141,000 families. It also constitutes highest percentage of the forest area of the states, in any sinmgle state or Union Territory at 8.79 percent. In Orissa only in eight districts namely Koraput, Ganjam, Phulbani, Kalahandi, Sundergarh, Keonjhar, Mayurbhanj and Sambalpur this practice is prevalent. The problem is more acute in South Orissa than in North Orissa. The Orissa Jhumming cycle is reported to vary between 5 and 14 years. In some localities the cycle is reported to be as low as two years.

In 1978, Food and Agriculture Organisation (FAO), and the United Nations Fund for Population Activities (UNFPA) sponsored a project on study of shifting cultivation in five countries viz., India, Bangla Desh, Thailand, Indonesia and Philippines. A report was brought out separately for India entitled Population data regarding forestry communities practising shifting cultiavation, 1980 (Task Force 1983). Few of the suggestions given in the report includes research work in certain areas namely (a) Study of changes in forest types, soil chracteristics and water regime during the shifting cultivation cycle. (b) evolving suitable agronomic practices to improve mixed cereal crop cultivation, (c) study of ethno-botny and ethno-forestry, etc. With the help of Indian Council of Agricultural Research (ICAR) complex for North Eastern Hill Region at Shillong, studies on the effects of shifting cultivation were made on rainfall, runoff, soil loss, nutrient loss, etc. But such studies have so far not been conducted in Orissa. Therefore the present study was unertaken in Orissa in view of the problem of this practice being acute here.

THE PROBLEMS

The problems related to shifting cultivation are of varied nature viz: runoff water, loss of soil moisture and nutrients, soil erosion, effect on vegetation, effect on population, etc.

Runoff Water

The ICAR study on North Eastern Hill region at Shillong on the effects of shifting cultivation is quite revealing. It was reported that runoff rain wter during the study period was 114 mm from shifting cultivation land, 47 mm from agri-horticulture land, 91 mm from agriculture land and 156 mm from agriculture (bunds) land.

Soil Moisture

Our investigation over Gaida Hills (Ganjam District, Orissa) revealed interesting facts about soil moisture content. The soil moisture content of cultivated site was higher in all depths of soil (0-10cm, 10-20cm, 20-30cm) than the other site not subjected to burning (controlled site) during rainy months (July-October) whereas its reverse was the case during winter (November to February) in the study year (Table 1).

Table 1. Soil moisture content at Gaida Hills, Orissa

Time of collection	Nature of site	Percent water content at different soil depths		
		0-10 cm	10-20cm	20-30 cm
April 1983	B	10.38	8.15	7.01
	C	10.20	8.25	6.95
May 1983	B	12,72	11.70	11.12
	C	12.97	10.85	10.56
June 1983	B	13.68	10.47	11.02
	C	13.08	10.07	10.13
July 1983	B	14.84	11.43	10.58
	C	12.97	10.02	10.04
August 1983	B	14.78	11.77	11.67
	C	10.73	9.67	9.40
September 1983	B	13.97	11.65	10.25
	C	12.98	9.95	9.58
October 1983	B	11.73	9.75	9.63
	C	10.85	9.93	9.76
November 1983	B	4.07	6.23	6.85
	C	7.87	7.26	8.68
December 1983	B	2.28	4.57	3.06
	C	4.96	5.05	6.27
January 1984	B	1.47	2.21	4.98
	C	2.83	5.04	5.97
February 1984	B	2.03	2.67	3.03
	C	3.86	4.02	4.86
March 1984	B	3.37	3.25	3.06
	C	4.02	3.98	4.55

B= Burnt, C= Control

Soil Erosion

During the ICAR study the landuse based data indicated that when the annual rainfall was 1628 mm, the soil loss per hectare as 416 quintals from shifting cultivation land where as it was only 30 quintls from agri-horticulture land. 20 quintals from agricultural land and 172 quintals from agricultural land (bunds).

According to Mooney (1961) at the instance of the then food commission of Orissa. it was estimated that more than 32,691.20 sq. km land, i.e. one fifth land surface of Orissa was under acute ersosion due to shifting cultivation. The Task Force also identified the area to be 30,000 sq.km as on 31 March 1982. Soil erosion. means loss of fertile top soil (Kelkar 1983) representing loss of land productivity. According to Government of India Ministry of Agriculture (1980) India sustained colossal loss of soil due to erosion (Table 2).

Table 2. Land degradation due to soil erosion

Causes	Area affected (million ha)
Soil erosion	150.0
Waste land fit for reclamation	6.6
Saline soils	4.5
Waterlogging	6.0
Shifting cultivation	3.0
Alkaline soils	2.5
Diara land	2.4
Total	175.0

Nutrient loss

The ICAR study under reference disclosed that the loss per hectare of carbon, phosphate. potassium from shifting cultivation land was relatively more (Table 3).

Table 3. Nutrient losses from the experimental watersheds

	LAND USE			
Nutrient (kg/ha)	Shifting cultivation	Agri-Horti-culture	Agriculture	Agriculture (bunds)
Org. Carbon	703*	35	31	251
P_2O_5	146*	11	10	96
K_2O	7*	71	71	3

* Average of two years where the area is under cultivation.

Effect on Vegetation

Our study of biological spectrum of forest vegetation over Gaida Hills revealed that the jhummed site encouraged more of annuals (therophytes) at the expense of prernnials and trees (phanerophytes) as removal of forest cover makes the soil open and changes the microclimate of the site. The study conducted during 1983-84 at the above site indicated that the site was phanero-therophytic which after shifting cultivation turned to be thero-phanarophytic compared to the controlled site. Ramakrishnan µ1983° reported that the effect of short jhum cycles is the rapid growth of various weed species resulting in depletion of the germplasm because of drastic changes in micro-climate and other elements of the habitats.

Effect of Population

The areas inhabited by shifting cultivators are sparesly populated. in general, with varied population density of 6 to 60 per sq.km. as against 173 for the country as a whole. Even this low density of population tends to exert heavy pressure on land. Because most of these poeple are landless and they take to shifting cultivation over no man s land, i.e. forests.

In certain parts of the country (particularly in Orissa) the habit of rearing livestock in large numbers which depend on land for free grazing is another factor for speedy degradation of land.

CONCLUSIONS AND SUGGESTIONS

National Commission on Agriculture (NCA, 1976). Food and Agriculture Organisation (FAO). United Nations Fund for Population Activities (UNFPA) sponsored project "Population Data Regarding Forestry Community Practising Shifting Cultivation" (1980) and Indian Council of Agricultural Research (ICAR) worked out some solutions earlier in order to solve the problems arising out of shifting cultivation. After reviewing them, some suggestions are made here.

1. Provision of permanent cultivation to shifting cultivators along with infrastructure facility and financial help for energy subsidies like fertilisers, irrigation, etc. and introduction of improved seeds and modern agricultural methods.
2. Development of water harvesting devices as suggested by ICAR to make use of runoff water from hill slopes for crop irrigation, pisciculture, etc.
3. Application of do-it-and-see technique to educate the jhumias about the benefit of rationalisation of this prctice. People are touched more by examples than by advices. The demonstration plot

may be divided into two equal halves for comparing traditional shifting cultivation modern agriculture. The difference of these two methods will speak of the profit.

4. Provision of alternatives to irrigation. This may include plantation. overdegraded forests and hills. horticultural operation. etc. keeping cereal cultivation to a minimum to avoid losses through soil erosion. This will give dual benefit namely rehabilitation of degraded land and eonomic benefit to jhumias.

Replacement of jhum by intensive agricultural practice has not been recommended as a realistic solution to the problem either. The limitations include the traditional life style of the people (mobility of the tribes). erosion, heavy inputs for preparing terraces along the slopes, etc. (Ramakrishnan 1983).

The Orissa Environmental Society. a voluntary organisation in Orissa. conducted a number of peoples workshops in Phulbani, Koraput and Ganjam Districts- all podu affected areas. The rural and tribal participants suggested that while making plantation the tree species must be selected as the local people desire and the area should be left to them for after-care and benefit. This confirms the UNFPA recommendations. Further, according to them the shifting cultivation practice is tedious and less paying and they offer to give up the practice once they are alloted agricultural land for cultivtion (Padhi 1982). Our study conducted on Gaida Hills in Ganjam District of Orissa in 1983 reveled that the per acre annual revenue from this cultivation was hardly about Rs. 200 per year.

5. Effective field based research to improve this baneful practice must be encouraged. The direction of research should be towards rehabilittion of podu ravaged forests and hill slopes which is imperative for restoration of ecology and while doing so the socio-economic rehabilitation of people should not be overlooked.

6. Jhum control act/regulation- The National Forest Policy, 1952 laid stress on weaning away the primitive people by persuasion from the baneful practice. It is necessary that the cultivation has to be regulated. if not stopped altogether, so that fresh intrusion into the forsts does not take place.

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EMERGING PROBLEM OF POLLUTION IN THE DOON VALLEY

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INTRODUCTION

With the Himalayas, Siwaliks, Ganga and Yamuna forming its natural boundaries is the Valley of Doon rich in flora and fauna. Lying between 77° 35 E to 78° 19 E longitude and 29° 57 to 30° 30 N latitude, it represents one of the important ecological entities of our country. Not only it owes its popularity as a hill resort to its balmy climate but also to its rich animal life, dense forests and its luscious fruits. It was in Doon where, for the first time in India, the Chinese tried the tea plants and along with them they brought the Litchi saplings. This Litchi took to the climate of DehraDun and grows most luxuriantly to this day in every house where one will find at least one Litchi groove. Nature has also bestowed the rich resources of a large variety of minerals particularly limestone, pyrites and phosphates in the Himalayas. Mining of these minerals in the area has also boosted the status of Dehra Dun. Urbanization also accelerated the growth of many industries including the lime industry and Doon Valley distillery. Concerned with material acquisition, flogging the pace of progress, we have become too accepting, may be even careless about the ecological disturbances that constantly recverbverate around us. With environmental compromises not only the flora an fauna but the water, the soil and the air ofthis valley are being directly affected.

The present paper deals with some hydrological and environmental problems in Dehra Dun which have altered the face of the Valley from beautiful lush green to ugly and scarred one. For a more comprehensivce study of the pollution problems case studies were made.

CASE I. LIME INDUSTRY

Lime industry is one of the oldest in the valley and was established sometime during the middle of the century. Ever since then it has been growing to its present position with more than 150 kilns located along the river Rispana. The simultaneous operation of these smoking stacks almost in the heart of city has created much concern among the environmentalists. The pollutants from these kilns, both gaseous and particulate, are a constant

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Dept of Botany, D.A.V. Post-Graduate College, Dehra Dun, India threat to both vegetation and inhabitants of the area. A survey was carried out in neighbouring areas of these kilns. Residents of the Kashi Mani Ashram locality. Dalanwala and Adhoiwala were interviewed to acquaint us with problems that the residents face. Almost all persons complained of one disorder or the other. The results are summarised below (Table 1).

Table I. Effect of air pollution on the health of the residents of the areea.

Type of disorder	% of the persons suffering from disorder			
	Children below 10 years	Persons 10-20 years	Persons 25-40 years	Persons above 55 years
Breathing trouble mainly due to suffocation	20	13.8	20	17.8
Pneumoconiosis	19.4	8.0	2	20
Bronchitis	20	--	12	11.8
Cataract	--	--	10	15.8
Other coronary disorders	20	25	5	10
Skin disorders	4	8.5	18	--

It was also common that the same person complained of more than one disorder in some cases. We suspect that one disorder often made them more susceptible to other disorders.

Some cases did not have any complaint at all. This was either attributed to their short period of setlement in the area or to their having accustomed to local conditions gradually. Most disorders resulted from inhaling the dust that became permanent part of the air and resulted from transportation, processing and packing of proucts. This dust also entered the eyes and settled on skin surface causing coronary diseases and skin disorders respectively. Chemical analysis of the dust identified it to have oxides of calcium, sulphates and chlorides. A measurement of the rate of dust settlement on surfaces was made using standard methods (Warner 1974) and dust load as high as 1063.5 mg/m /day was observed. Plunkett (1966) described similar disorders due to CaO and determined a threshold value to be 1 mg/cu.m for the presence of CaO in atmospheres around the lime industry and predicted toxic effects at concentrations above these. Negi (1983) also reported cases of acute pneumoconosis in persons working in the mines or residing in neighbouring areas. The gases from the lime kilns have also contributed to various disorders mentioned above. It is also evident from the data that certain distinctions that setthe young apart from adult play a role in air pollution difficulties experienced in many children. The tendency towards breathing trouble develop eearly in life. Next section of people most affected include the older people. It is tragic to realise that thiscity which gained its popularity as a "city of green hedges and grey heads" had very litle to offer to older people who settled here after their retirement because they found the serenity and greenery of the mountains all conducive to the type of life they looked forward too.

The plants too are mute sufferers much at the expense of unfavourable alterations in their environment. Several Orchard trees like *Mangifera indica*, *Psidium guajava*, *Citrus* and Litchi failed to yield good fruits. Ornamentals like *Nerium* sp. and *Chrysanthemum* sp. had poor bloom in the vicinity of the industry. Often the leaves of many plants remain coated with dust. This dust hinders light penetration into the leaf and thus hamper photosynthetic activities which are reflected in reduced pigment concentration of some plants.

Table 2. Comparison of chlorophyll content (mg/g) in some plants from polluted and healthy areas.

Plant	Population status	Chlorophyll a	Chlorophyll b	Total Chlorophyll
Mango	Polluted	0.22	0.37	0.59
	Healthy	0.33	0.52	0.85
Citrus	Polluted	0.31	0.42	0.74
	Healthy	0.45	0.93	1.38
Litchi	Polluted	0.62	0.72	1.34
	Healthy	0.83	1.15	2.03

Reduction in chlorophyll content which has been regarded as an index of productivity (Bray 1960) has also been reported by Lal and Ambasht (1980) and Yusuf and Vyas (1983) in plants growing around cement industry, by Mall and Singh (1977) and Srivastava (1983) around other industrial areas. The alteration of the soil properties by addition of bases and effluent gases from the kilns together change the physiology of these plants both by altered gas exchange and mineral uptake from the soils. These physiological and biochemical changes result in poor yield of some economically important plants of the area like wheat and Arhar. Among the orchard trees that suffered much were Litchi and Citrus, and both have been favourite with the people of Dehra Dun. Some old residents of the valley recall the nostalgic memories of the days when there were so many Litchi trees that they just had to raise their hands from their terrace to pluck the fruits from the dense groves but today we see thesetrees in dwindling state with poor yield, low pulp content and less palatability. Variation in edible part (as much as 21.28%) has been reported from most polluted areas. Similarly average weight of fruit from most polluted areas is as low as 10.53 g compared to 14.65 g from non-polluted areas.

CASE II. DOON VALLEY DISTILLERY

Hydrological problems that the valley faces are those that emerge from a distillery situated in a near by area. This distillery is located in Kuanwala a few km away from the town and its products are chiefly country spirit. River Reh which carries the effluents discharged from this distillery has a serious threat to the quality of its water. Analysis of the effluents and the receiving water system was carried out following the methods sugested by Welch (1948). Pollution source from the distillery which pose a threat is spent-wash from fermentation tanks.

The following table shows the levels of various chemicals in the effluent and receiving water.

Table 3. Analysis of certain physico-chemical parameters of effluent and receiving waters

Parameters	Effluent	Receiving water
Temperature °C	63.0	30.0
pH	3.2	3.2
Total solids (ppm)	1750	1680
Dissolved CO_2 (ppm)	3073	1076
Chlorides (ppm)	1170	1100
Sulphates (ppm)	1400	1158
BOD (ppm)	40,000	30,000

With above observations at hand it will not be difficult to list the pollution effects of these effluents. Analysis of waste water for phytoplanktonic components reveal the presence of species of *Microcystis*, *Anabaena*, *Chlorella*, *Protococcus*, *Phormidium*, *Gleocapsa* and *Chaetomorpha* along with some unidentified species. Abnormally high and constant temperature, presence of total salts, low dissolved oxygen content and excess of carbon dioxide create ideal environment for bloom forming blue green algae like *Microcystis*, *Anabaena* and *Nostoc* (Palmer 1980).

These species grow exponentially for several weeks and form dense bloom. These algae usually have vacuoles filled with air or gas which expand in the warm water and rise to surface forming dense scum, thus preventing light penentration to lower layers and decreasing the oxygen content considerably. All these events cause the death of number of fishes and other aquatic animals.

Similar reports of increased mortality and reduced fish size have been reported by other workers also.

The nature of toxic substances in Microcystis is however not known but the most common clinical infestations have been those involving the gastrointestinal tract. Several cases of conjunctivitis and asthama have been observed in patients who had a swim in the lake with algal bloom. The effluent stagnates in the drain or in stream in absence of oxygen or may get decomposed anaerobically by the action of micro-organisms which lead to production of several obnoxious compounds and gases like methane, amines, mercaptans, hydrogen sulphide and phosgene all having ill odours. These compounds degrade the status of receiving waters and are as such detrimental to life (Verma et al. 1979).

Apart from the above mentioned problems of pollution that challenge the valley are those from mining. The serious environment impact of mining is loss of surface cover and vegetation and along with it is the loss of top soil which nature build up perfectly although slowly. The loss of top soil often facilitate the reaction of various rock chemicals with water rendering it unfit for agriculture, and more so for human consumption.

CONCLUSIONS

The above findings do not justify public alarm but suggest an area warranting more systematic and extensive investigations. Methods for abatement of pollution in the industries should be designed at the time of setting the industry. The realisation to preserve the greenness of the land and the health of the people should be the objective of the residents of the valley. It should be borne in mind that development of the industries in the area should be in a consonance with benefits from natural sources.

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ENVIRONMENTAL MONITORING IN CONSERVATION

S.T. Tilak*

INTRODUCTION

Indoor air is usually exchanged, fairly and rapidly by ventilation with outside air. Because of this exchange the microbial content of the air indoors tends to change. However, indoor pollen and spores are usually very much lower in concentration than outside air. But added to microbes coming in through the window, or ventilators indoor air commonly has other microbes derived from indoor sources. The microbial flora of the indoor air depends on the number and kind of organisms present and the mechanical movements within the enclosed space (Madeline and Linton 1974).

The problem of the deterioration of wall paintings caused by biological agents has assumed serious proportions in many countries and is a matter of great concern. In the early stages of attack by biological agents, it is easier to check the growth but once the malady becomes widespread it is extremely difficult to deal with. It is with this idea the preliminary survey for the air-spora at Ajanta, Ellora and Aurangabad caves was undertaken.

Several hyphomycetes cause biodeterioration of frescoes and painted canvases, e.g. species of Penicillium, Cladosporium, Fusarium, Gliomastix, Sporotrichum, Aleurisma. Damage is particularly common under conditions of high humidity and poor ventilation. In a study of fungal deterioration of frescoes in churches in Florence in Italy following floods in 1966, Gargani (1968) reported several species of Penicillium as the most common causal moulds. Application of nystatin controls growth of many of the fungi and prevents deterioration of paintings. Painted surfaces must be washed down with ammonium carbonate following use of the antibiotic. With water soluble nystatin, this kind of treatment has proved effective for application as a preservative for both unaffected and damaged paintings.

The deterioration of library materials by micro-organisms has attracted the attention of many in recent years. The role of biodeteriogens and the deterioration with reference to libraries and museums had been recently reviewd by many workers (Greathouse et al. 1954, Flyste 1968, Gallow and Fustal 1963). The presence of actinomycetes in the library has been reported by Kowalik and Sadurska (1961). Aleksi (1985) reported species of 18 fungi on stored manuscripts. The efforts are directed towards reduction of

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these losses by finding out the conditions, causes and environmental factors which contribute to the biodeterioration of books and the binding material like leather, rexine and cloth.

Considering the significant role of air-borne biodeteriogens in its deliterious effects on cave paintings, library materials, extensive air monitoring forms a need of the day and has recently attracted many workers and these investigations have brought out meaningful information.

MATERIALS AND METHODS

The Rotorod samplers of Perkins (1957) modified by Harrington (1959) were operated inside the Ajanta, Ellora and Aurangabad caves, library builldings. The Tilak air Sampler (Tilak and Kulkarni 1970) was operated inside the caves. Other materials and methods used in the present study were same as reported by Tilak and Kulkarni (1972).

RESULTS

Investigations in Aurangabad (Tilak and Kulkarni 1972) caves were initially carried out to assess the presence of microbial populations. These investiations clearly pointed out the significant contribution of air spora. Further studies in Ellora caves and Ajanta caves were undertaken (Tilak et al. 1972), which were characterized by frescoes and paintings respectively.

Ajanta caves no.17, 16 and 1 were selected to study the airspora. During sampling time the scrappings from paiantings at differnet levels and points were selected for microscopic observations. The Spore types like Aspergillus, Curvularia, Cladosporium and Ascospores are common in all the three caves. Air-spore was studied at two caves of Ellora, 16 and 32 as these caves carry important paintings and deterioration is muuch marked here. Here it was also observed that the insect scales are much abundant in cave no. 32, particularly the ground floor. It was due to the presence of many bats and other birds in this cave. The insect scales and insect body parts as well as ascomycete spores were also observed along with the excreta of bats and fallen acrappings of paintings.

In their extensive studies (Tilak and Vishwe 1975, Tilak et al. 1982, and Tilak and Saibaba 1984) inside the library buldings 60 fungal spore types were caught of which 11 fungal spore types exhibited paper deteriorations activity. These 11 fungal spore types and insect scales constituted 92 % of the total air-spore and remaining 49 spore types and binding threads constituted 8% of the total air-spora. The samples of the humid walls after critical examination indicated presence of Cladosporium, Aspergillus and Penicillium. These may also be the source of air-spora inside the library. It is clear from the data shown in Table 1 that 11 fungi had deteriorating activity. In order to understand the relationship between cellulase production and paper deterioration, the fungi were grown on different papers and paper materials as substrates. All the isolated fungi practically deteriorated all types of paper materials and possessed cellulolytic acticity in culture filtrates.

All the fungi, taken for the study, were deteriorating Glossy paper (GF), and Rexin (R) very less. However, Aspergillus and Chaetomium were responsible for the deterioration of book paper (BP) more than other papers.

DISCUSSION

The air-spora inside the caves is more than outside the caves. The occurrence of fungal spores especially of ascomycetes on excrete of bats in air and on the paintings possibly suggest that some coprophilous fungi are predominating in the decomposition of paintings. Imperfect fungi like Cladosporium, Aspergillus and others which are commonly abundant on the paintings and in air may also be responsible in playing the active role.

Curvularia, Aspergillus, Alternaria, Nigrospora, Periconia, Helminthosporium, Bispora, Fusarium, Torula, Cladosporium and Pithomyces were of common occurrence in the air of library as well as found associated with the deteriorated samples of books.

Regarding the cellulose destroying activity and the damage of books by the common air-borne fungi like Alternaria, Penicillium, Bispora, Chaetomium, Cunninghamella and fulfilled. When deterioration ability and enzyme production by fungi on different cellulolytic substrates were compared, it was noted that Cunninghamella echinulata deteriorated Newspaper (NP) more, although the production of enzyme was low. On the contrary in case of Rexin (R) and leather (L) deterioration was very less whereas enzyme production was maximum in culture filtrates. Such relationship has also been found in other fungi study.

On the basis of observations, suggestions are also made to prevent the damage by using fungicides and insecticides, and avoiding highly humid conditions by maintaining the temperature.

Over long periods paintings tend to deteriorate and there is an urgent need for restoration for which a multidisciplinary approach involving microbiologists, aerobiologists, biochemists, pollution scientists` and archaeologists has to be undertaken. The role of deposition of dust particles on the paintings is not significant. Often the paintings are coated with varnish which is initially smooth and transperent but graduallоy looses its flexibility. Often the coated surface changes its colour and gradually may be scratched by accident or due to deliberate action of visitors.

The preservation and conservation of the wall paintings of

Ajanta is thus vitally important in protecting our national heritage and pending further investigations following points should be given importance on war footings.
1. Excessive humidity inside the caves can be reduced by checking water percolation especially during rains.
2. Scientific preservation and restoration could be achieved by fumigation.
3. Spray of fungicides has to be undertaken which would inhibit the fungal growth.
4. In spite of repeated warnings by several committees of the Central Government and scientists, cave No.17 with important paintings is still closed and this has made the problem more serious since it has helped the development of a congenial environment for the growth of microbial population inside the caves, thus defeating the very purpose of conservation.
5. Extensive and intensive investigations with multidisciplinary approach should be undertaken without further delay.

Table 1. Percent contribution of some important spores and other micro-organisms inside the caves and library

Spore Types		Aurangabad Caves	Library building
Alternaria	-	1.40	5.76
Aspergillus	-	-	7.93
Bispora	-	-	4.58
Chaetomium	-	-	3.39
Cladosporium	30.00	60.42	2.69
Cunninghamella	-	-	0.38
Curvularia	5.29	1.40	11.89
Helminthosporium	3.98	2.30	5.38
Hyphal fragments	-	-	7.80
Insect scales	5.05	9.00	-
Nigrospora	3.30	2.20	-
Paecilomyces	-	-	7.51
Pencillium	-	-	0.35
Periconia	-	1.30	5.63
Protozoan cysts	6.80	4.90	-
Rhizopus	-	-	1.38
Rust spores	6.00	8.03	-2.80
Torula	-	-	0.47
Trichoderma	-	-	

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ECOLOGICALLY SUSTAINABLE PRODUCTION OF PROTEIN FROM AGRICULTURAL BY-PRODUCTS AND ITS SIGNIFICANCE FOR ENVIRONMENTAL PROTECTION

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INTRODUCTION

Mushrooms have played an important role in the diet of many people for thousands of years and were prized for their flavour and condiment characteristics. However, it is now being increasingly realised that they are rich in protein and thus constitute a valuable source of supplementary food. Mushrooms belong to the group of organisms known as fungi. Fungi are non-flowering plants which because of their dependency upon organic matter for nutrition do not need and are devoid of chlorophyll. Instead they live saprophytically or parasitically or symbiotically with other organisms or on the products of decomposition or the excrements of those organisms.

The group of fungi, comprising perhaps some 100,000 species, shows an amazing variety of forms from unicellular organisms like the yeasts to giant mushrooms more than two feet in diameter. The fungi are economically important to man in numerous ways- antibiotic production, wine and beer making, bread making, food processing, livestock feed, medicines, plant and animal diseases and as human food.

The term mushroom has no definite botanical meaning but it is generally applied to the fruiting bodies of higher fungi. Not all mushrooms are edible. About 2,000 species are reported to be edible and only about 20 species have been brought under cultivation. Only a few of these are commercially cultivated on a large scale.

The use of mushrooms as food is probably as old as civilization itself. They have been reported as useful in food and medicine in India as far back as 3000 B.C.

EDIBLE MUSHROOMS

Bels (1978) has divided the cultivated mushrooms in the following groups as far as the material is concerned:

1. Fungi which grow on fresh or almost fresh plant residues:
   Lentinus, Flammulina, Auricularia, Pholiota, Tremella, Agrocybe, Ganoderma, Coprinus and Pleurotus
2. Fungi which grow on slightly composted materials:
   Coprinus, Volvariella, Stropharia.

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3. Fungi that grow on well or thoroughly composted substrates:
   Agaricus
4. Fungi which grow on soil and humus:
   Lepiota, Lepista, Morchella, Gyromitra
5. Mycorrhizal fungi:
   Boletus, Cantharellus, Matsutake, Morchella, Lactarius, Tuber

MUSHROOMS AND WASTE MANAGEMENT

The fact that edible mushrooms can be grown on wide variety of cheap and sometimes virtually useless wastes; e.g. agricultural wastes, industrial wastes, household wastes, enhances their importance as food material. The spent compost left behind after harvesting the mushroom is a good manure. The mushroom production industry can therefore be promoted on sound organic recycling principles. It has been estimated that if only one-fourth of the world's annual yield of straw (2,325 million tonnes) is used to grow mushrooms, about 370 million tonnes of fresh mushrooms could be produced. Such an amount would provide 4,100 million people with 250 g of fresh mushrooms daily. This is the magnitude of the potential available.

In view of the current energy, food and population problems, the role of mushrooms in providing human nutrition is being increasingly debated. Attention is being seriously given at the present time to the possibilities of their use as a source of protein to enrich human diet in underdeveloped countries. Mushrooms have been recognised by the FAO as food, contributing to protein nutrition in areas of the world which depend predominantly on cereal diets.

CULTIVATION OF AGARICUS BISPORUS

The first attempt at aritificial cultivation of A. bisporus was made in France during the second half of the 17th century. Caves and cellars were used along with horse manure and straw, the fermentation of which liberated natural heat. In the 20th century, the cultivation of A. bisporus had greatly increased, particularly in the United States.

Morphology

Agaricus bisporus belogs to the family Agaricaceae. The pileus is fleshy, convex, flattened at full growth; measures 6-12 cm in diameter; the surface is silky or sightly and lightly flaky and the most commercially valuable strains are brownish and shared at the edge. The hymenium is gilled, first covered by the veil that remains hanging from the stipe in characteristic fragments; the gills are pinkish and tend to dark brown at full growth. The stipe is hard, full, fleshy, 8-10 cm high, but in the most valuable strains it is short, stumpy and as large as the pileus; silky and whitish in colour. The spores are brown, 7-8μm long and 5-6μm wide.

Cultivation

Air circulation is the most important factor in the successful cultivation of A. bisporus. The two most common methods of cultivation are the intensive method and the extensive method. The first is particularly suitable for optimum space utilization. The substratum or bed is prepared on layered grates large enough to permit suitable cultivation, ease of picking, and spaced out in height for air-circulation and fungal growth. Modern grates are of plastic, easily washed and non-perishable.

The second method consists of cultivation on substratum contained in plastic bags that may either be laid on the ground or hung on layered grates to permit air circulation. While with the first method the second method permits the complete preparation of the bags, including inoculation to take place outside, thus, avoiding the manipulation of organic matter which, even if partially sterilized, may contain parasites of A. bisporus. Various sites may be used for cultivation.

Preparation of Inoculum

The preparation of a suitable inoculum is essential for the succeess of the mushroom bed but, is above all of fundamental importance for a quality commercial product. The traditional method is still of considerable importance; an organic substance such as wheat or rye or other graminaceous seed is placed in special bottles (Roux bottles) and sterilized in autoclaves. The bottle is then aseptically inoculated with fragements of A. bisporus fruit-body and incubated at 24 °C until colonization of the medium. When possible, a preliminary isolation of the mushroom is advisable in an artificial agar substratum in order to control its sterility and origin. The pure culture prepared in this way may then be inoculated in the organic substratum of the bottle. Choosing well developed fruit-bodies of different origins is advisable in order to obtain a rapid growth and a vigorous strain producing fruit-bodies of good quality.

Substratum Preparation

The substratum used in the cultivation of A. bisporus must present several qualities in order to give regular and prolonged growth of the fungus. The preparation entails several sterilizations but, dealing with organic substances, contamination is almost inevitable and may cause competition phenomenon during A. bisporus growth.

To avoid this inconvenience, the substratum should be very selective so as to follow the development of the mushroom and to impede that of the competitive microflora. For these purposes, straw and horse manure have, for hundreds of years, represented the most used material for substratum preparation. The natural fermentation of horse manure produces sufficiently prolonged heat to guarantee a suitable growth of A. bisporus and at the same time prevents the growth of competitive microflora. The insufficient availability of horse manure now-a-days has however, caused cultivators to use other organic matter, for example, bone and horn meal, dried cattle blood, manure of other animals, but, always adopting a substratum rich in organic substances.

Following is a popular formula for obtaining a successful substratum:

40 kg	fresh chicken manure
600 kg	straw
5 kg	urea
10 kg	ammonium sulphate

The raw material is placed in the substratum area and prepared by frequent turning-over to favour air-circulation and to block harmful anaerobic formentation. The mixture is placed in rows 1.5 m wide and 2 m high. Every three days the blend is mixed by special machines to favour aerobic transformation by the contained microorganisms. During this phase, the temperature rises to 80 °C when the mesophilic microflora is substituted by the thermophilic, which lasts during the use of the substratum. The mass should be aerated until it becomes homogenous, resistant to torsion, and brown in colour; when squeezed it oozes a colourless liquid; it should hold 70% of water and have a pH of nearly 8. The material thus prepared is then pasteurized at 55-60 °C for 3-6 days in suitable pasteurization chambers. Pasteurization duration depends on the maturity of the compound; it should no longer have any ammonia odour; should be brown, almost black in colour and have a smooth texture; pressed in hand it should not stain; the optimum humidity is from 65-77%; the pH 7-7.2. This process reduces the number of nematodes, accarids and insects normally present in this type of organic matter and also that of microflora, allowing Agaricus, once inoculated, a competitive growth with the other micro-organisms that colonize the substratum. Once pasteurized, the compound must be inoculated, and placed in the bags. Every possible external contamination should be avoided when bringing the closed bags to the mushroom bed, where they are beates on the surface, levelled and kept half-opened to favour the mycelial growth; then the surface is covered by about 2 cm of sterilized soil, and watered. The soil ingredients vary according to the habits. A mixture of 50% peat moss, 25% crushed gravel, 25% pozzolana may do; another variation is 50% peat moss and 50% fluvial sand. The importance of the soil cover is considerable; the transformation of the vegetative stage of the mycelium into a reproductive stage, that is, the production of fruiting bodies, totally depends on it.

The temperature of the mushroom bed should be initially kept at from 18-32 °C with a humidity of about 90%. Air circulation is also necessary but, should not cause condensation in the bags or rapid changes in temperature.

After this operation, the bags should remain half closed for 18-20 days, and be watered 2 or 3 times depending on the mushrooms bed conditions. It must be remembered however, that, excessive watering favours parasites, especially competitive fungal development, while scant watering slows down and diminishes production.

The bags should be completely opened on the 15th day and production should start on about the 20th day. The first production is undoubtedly the best; the fruiting bodies are not abundant but are big and well developed. After the first harvest, others may be reaped but production diminishes both in quality and quantity. After the fourth harvest, waiting for further production is usually no longer economically worthwhile.

The cultivation of A. bisporus is not easy and any small technical error may compromise the production result, but a simpler method of cultivation is being attempted.

CULTIVATION OF AGARICUS BITORQUIS

The distribution, physiology and morphology of this species are very similar to those already described for A. bisporus. Owing to its easy cultivation, flavour and popularity on the market, this mushroom seems promising for the near future.

The species differs from A. bisporus, producing basidia with four sterigmata by which the nuclei migrate, forming four regular basidiospores. Compared to A. bisporus, A. bitorquis is more resistant to infection, especially viruses. This characteristic together with its flesh consistency, has brought it to fame and its commercial preservation is believed to be superior to that of A. bisporus.

Morphology

This fungus belongs to the family Agaricaceae. The pileus is white with a smooth surface and measures, 5-9 cm in diameter. The gills are pink but rapidly turn dark brown. Stipe is short, large and fleshy, 2-5 cm in height and 1.5-3.5 cm in width, it presents a simple annulus. The spores are dark brown in the mass.

Cultivation

Cultivation does not substantially differ from that of A. bisporus. Although its resistance to infection is advantage, its higher temperature requirement renders its production more expensive. Since optimal temperature ranges from 22-26 °C, cultivation of the species is not recommended in caves where even 12-14 °C are hard to reach. Furthermore, since A. bitorquis gills rapidly turn dark brown, fruiting bodies must be picked when still closed and immediately before pileus closure. It must be emphasized that mechanical picking is hindered by the shortness of the stipe. A. bitorquis begins to fruit several days after A. bisporus. The first crop picking start 22-26 days after covering the substratum with upto 10-12 days between pickings.

According to Vedder (1978) inoculation of the bed requires five litres of inoculum per tonne of substratum. Since mycelium growth necessitates a carbon dioxide concentration higher than that of A. bisporus, covering the bed should be brought forward to 10-12 days after inoculation. This cover should also favour the optimum temperature which is 30 °C. A higher temperature may compromise hyphae vitality, while a lower temperature seriously redues development. In view of this fact, room ventilation is essential and should be regulated to prevent temperature increase as well as to maintain the carbon dioxide concentration. Once the bed and covering have been colonized, ventilation should be augmented to bring the bed temperature to 25 °C, that is, to the most favourable condition for fruiting. A. bitorquis is a quality mushroom of interest. It is easily preserved, sliced and dried. The most important aspect of its cultivation, however, is its temperature requirement. This fact should distinguish it as a significant source of income in tropical countris where it might bve grown concurrently with A. bisporus.

CULTIVATION OF PLEUROUS OSTREATUS

In adition to A. bisporus, another excellent mushroom, P. ostreatus, has in recent years been industrially produced.

This fungus belongs to the family Agaricaceae. The pileus is asymmetric, aplanatic, 5-15 cm in diameter; the surface is smooth and sometimes shiny, violet-black, brown brownish grey. Violet grey, margin is involute; the fleish is white and firm. The gills are dense, unequal, decurrent (descending down the stipe) and light ivory in colour. The stipe is 6-12 cm high and 1-1.5 cm wide, firm, dense and lateral.

Cultivation

Cultivation techniques have been set up by Ferri (1972 a,b). The author suggests inoculation of poplar branches 30 cm long and

15-20 cm wide, buried at about 15 cm in a shaded field and abundantly watered. Ferri (1972, b) also set up cultivation techniques on organic substrata composed of corn-cob in plastic bags. Once inoculated, bags are left open and layered. Mushroom fruiting bodies then develop. Both methods offer very promising results, both in quality and quantity.

Pleurotus has also been grown successfully on shreded paper. A sterilized mixture of thoroughly wet paper with small smounts of calcium carbonate and wheat bran has been shown by Steinkraus (1978) to be an excellent substrate. Straw, the simplest, most readily available nutrient base has been studied to determine the products of its decomposition during P. ostreatus growth. All the methods mentioned need a constant temperature of 25 °C to allow colonization of fruiting-body development.

CULTIVATION OF PLEUROTUS ERYNGII

Ferri (1977) again has recently and successfully experimented with the industrial production of P. eryngii. This mushroom is of extremely high quality and is very suitable for preservation. This mushroom belongs to the family Agaricaceae. The pileus is fleshy, 4-15 cm in diameter, convex or flat, grey-white in colour, with involute margins. The gills are cream yellow, decurrent on the stipe; the flesh is white. The stipe is whitish, 3-10 cm high and 1-3 cm wids. The spores are cylindrical, whitish, 10-14 x 5-6 µm.

The substratum used for the cultivation of this mushroom is the same as for P. ostreatus. It must be thermically treated in order to eliminate those micro-organisms capable of competing with P. eryngii 's growth. The substratum is then placed in bags, inoculated and incubated at 25 °C. After 40-50 days of incubation the material is layered in pits, 1 m wide and 25 cm deep, filling them almost to the top with soil. The poits are then covered with about 2 cm of soil and sprayed with water. After a few days the first fruiting bodies appear. Picking may be repeated and is usualy exhausted within 45 days depending on latitude and on the season; the ideal is a temperature of 20-23 °C, moderate sunlight and high humidity. To obtain those conditions, shading and irrigation are recommended (Ferri 1979).

The inoculum preparation is identical for both fungi, inner portion of flesh is aseptically removed from a vigorous and well developed fruiting body and placed in a test-tube containing agar. This pure culture is inoculated on an organic substratum composed of ground corn-cobs, millet seed, sorghum seed, maize seed, etc., contained in flasks previously sterilized in autoclaves or in a hot bath. If culture on an agar substratum is not possible, the aseptically withdrawn fragmentsof the fruiting-body may be directly inoculated in bottles containing the sterilized substratum. Incubated at about 24 °C, the fungus colonizes all the substratum at its disposal. The prepared inoculum may then be used on tree trunks or in plastic bags containing the substratum.

CULTIVATION OF VOLVARIELLA VOLVACEA

Cultivation of V. volvacea in China and neighbouring countries has the same economic importance as that of A. bisporus in Europe.

V. volvacea belongs to the family Agaricaceae. Ripe pileus reaches about 6-10 cm in diameter, regular with continuous edges; surface is smooth, dark green in the centre and light green on the edge. The gills are straight and vary in size; even the large stones do not reach the stipe (Change 1972). The stipe is in the centre of the pileus, 8 cm high and 0.5-1.5 cm wide, white fleshy ringless; with a volva, light brown in colour at the base, cup-shaped, fleshy and with irregular edges. The basidiospores are oval, rather irregular in shape, slightly asymmetrical, 7.9 µm - 5.6 µm; their wall is thick and smooth; they are dark brown when ripe.

Cultivation

Volvariella may be cultivated in beds similar to those used for A. bisporus, however, the ambience must be lit by a 50 ft-candle and maintain a constant temperature of 28 °C during the entire season of cultivation. Furthermore, it should be naturally or electrically ventilated, air-circulation being fundamental to successful cultivation. Rooms similar to plastic green houses may be prepared. This mushroom can be cultivated in the tropics without special equipment.

Vegetal organic residues are used for bed preparation. Rice straw and residues of cotton are principally used. First the cotton material should be well dried. Second, it is thoroughly washed, piled up, covered with plastic sheets and left to ferment for about 2 days. Finally it is placed in layers, 12-20 cm high and covered with 5-10 cm of fermented ricestraw. The fermentation of the cotton residues assures sufficient heat for the whole, while the rice straw forms the basic substratum on which the mycelium develops and produces fruiting bodies. After the bed preparation, the inoculation takes place by placing mushroom fragments on the straw, 10-15 cm apart. The whole is then moistened and covered with a plastic sheet to avoid evaporation and to maintain the correct temperature for mycelium growth. This temperature reaches a constant 30-32 °C in the bed if the room remains around 28 °C. Humidity should be maintained by watering.

If conditions remain optimal, production of fruiting bodies begins 10 days after inoculation. Over the following three days production reaches its climax and the fruiting bodies may be picked even twice a day. They should be picked when still young, that is, when the volva still encloses the pileus and immediately prior to rupture. The fruiting body should be completely eradicated and not cut, so as toavoid leaving fungal residues to attract parasites capable of damaging the entire production.

The best production is obtained by inoculating the fungus from a pure culture that is isolated on an artificial agar medium by means of an aseptic withdrawal of a fruiting-body frament placed directly on the substratum. Under these conditions, the hyphal cells germinate and originate a new colony. Due to its characteristics, V. volvacea, may be easily cultivated outdoors also. Areas that are hot, well shaded and possibly protected from rain are necessary.

CULTIVATION OF COPRINUS FIMETARIUS

The genus Coprinus includes several edible species unfortunately of no commercial value because of the difficulty of maintaining its freshness during transport to market. However, fruiting bodies of C. fimetarius last for about 3 days under refrigeration before deterioration. In addition, it has the necessary qualities for drying or jar preservation. Moreover, it is easily cultivated and excellent in flavour. This species has no particular requirements, adapts to the most varied temperatures and is found in practically all temperate countries.

Morphology

C. fimetarius belongs to family Agaricaceae. The pileus is campanulate, cylindrical, 0.6-2 cm wide, 0.8-2.5 cm high; initially covered by a veil surface is smooth and pure white in colour. The stipe is 1.5-5 cm high, 5-8 mm wide, clavate, volva of diameter 0.6-2 cm. Surface is tomentose and pure white. Spores are black, smooth, 8.5-1.5 X 6.6 µm.

Cultivation

The optimum temperature for growth is usually between 35-40 °C; nevertheless, C. fimetarius grows well below 20 °C. Relative humidity is important and should be maintained around 80%. Fruitbody production may be made easier by using low-intensity blue light (flourescent commercial light) on the beds.

According to Kurtzman (1978) the substratum components should include; straw, water and calcium nitrate. The straw must be fresh, undeteriorated and unwashed. It is moistened with hot water (80 °C) three or four times the straw weight, pasteurized and 50 kg of calcium nitrate per tonne of water and straw is added. The well mixed substratum is layered 15 cm high in the bed. The mixture should fill half the depth of the bed.

C. fimetarius cultivation requires neither heating nor ventialtion, which brings its cultivation cost down to the lowest of all mushrooms.

The inoculum is prepared by isolating the fungus on pure culture and cultivating it in sterilized sorghum seeds, in Roux bottles, incubated at 30-35 °C. The mushroom colonises with extreme rapidity. The crumbled inoculum is spread and mixed with the bed surface which is 5% of the straw weight.

Fruiting begins two days after substratum colonization. Since the fruiting bodies mature in a short time, the cultivator should crop quickly in order to avoid deterioration. Artificially lit mushroom beds contribute to uniform maturity and permit systematic picking.

During harvest and above all between fruiting, the bed should be kept damp. Production terminated when straw no longer retains the water which rapidly drains from the bed.

The cultivator may obtain up to 60% of the bed weight by operating sensibly. Production therefore, surpasses that of A. bisporus. The low production costs renders this mushroom profitable, especially in the topics.

CULTIVATION OF FLAMMULINA VELUTIPES

Flammulina velutipes is one of the most cultivated mushrooms in Japan. Valued for its delicacy of flavour and for its ease of cultivation on poor substrata.

Morphology

F. velutipes belongs to family Tricholomataceae. The pileus is 2-3 cm in diameter; hemispherical, then flat at maturity. The surface is lightly viscous, yellow-brown or dark brown with shaded margins. The flesh is whitish. The gills are whitish or cream coloured; decurrent on the stipe. The stipe is 2-9 cm high, 2-8 cm wide; base dark brown and becomes lighter at the tip. The spores are white, cylindrical and oval, 5-7 x 3-4 µm.

Cultivation

The fungus causes wood decay, and may be grown on broad-leaf and conifer tree stumps. Also thrives and fruits on agar media in laboratory.

Sawdust mixed with rice husks is the most commonly used substratum in Japan. Sawdust of broad-leaf trees is much more suitable and profitable than that of *Cryptomeria japonica* and *Chamaecyparis obtusa*, both native of Japan. The substratum is prepared by mixing four parts of sawdust with one part of rice husks, adding 58-60% water. 1000 ml bottles are then filled with about 540 g of the mixture, stoppered with cotton, and sterilized in an autoclave for four hours at 95 °C (Tonomaaru 1978). After sterilization one or more bottles are inoculated with aseptically teased-out sections of fruiting-body or even better, with the mycelium obtained from pure cultures on agar media. The bottles are incubated at 22-24 °C. Once colonized, part of the inoculated medium is transfered into the remaining bottles. A bottle of 1000 ml generally suffices to inoculate 50 to 60 other bottles. The inoculated bottles are then placed in special chambers where the temperature is maintained between 18-20 °C. The mycelium invades the substratum within 20-25 days. The bottles are then opened and the substratum surface leveled to stimulate fruiting. The bottles thus surface levelled to stimulate fruiting. The bottles thus prepared are placed in dark rooms at 10-12 °C temperature and 80-85% humidity. Moisture regulation and a steady temperature are esential for fruiting. The earliest stages of development appear in 10-14 days. During this period, the temperature is lowered to 3-5 °C to allow for a more slower but more regular growth. When the stipes reach a height of about 2 cm, temperature is brought up to 5-8 °C and humidity maintained at 78-80%. The stipe continues to grow and are supported by paper or plastic strips placed on the necks of the bottles.

When the fruit-bodies are about 13 cm high, the strips are removed and the mushrooms are picked. The maturation of the fruiting bodies takes 50-60 days. Some bottles may fruit a second time but production is limited. The first production yields 100-400g and the second only about 60-80 g.

F. velutipes, thus has low substratum requirements but since it demands particular temperature and humidity conditions, its cultiation becomes costly.

CULTIVATION OF LENTINUS EDODES

This mushrom is very popular in eastern Asia, especially in Japan, for its quality and easily prepared beds. It may be cultivated by small farmers and by families and is very convenient when dried. In Japan it is considered a choice food source and is regarded as having nutritional value and healing powers.

Morphology

It belongs to family Tricholomataceae. The pileus is small, fleshy and firm. From a dried state, it resumes its morphological characteristics when moistened. The stipe is central and the flesh firm. The gills are decurrent. The spores are smooth, white and elliptical.

Cultivation

Since Lentinus edodes is a wood-attacking fungus, it is cutivated on oak and chestnut (Castenea *crenata*) logs and on those of some hornbean (*Carpinus*), alder (*Alnus*), and maple (*Acer*) species. Holes are drilled in the logs and filled with pure cultures of *L. edodes*. After inoculation, the logs are placed in a fenced area which the Japanese call laying yard . The area should not be extremely humid, because humidity may considerably reduce the production. On the contrary, the logs should be placed in a well ventilated area. The ideal temperature for fungal growth is between 24 and 28 °C. Following mycelium development, the logs are transferred to the so-called raising yard . The conditions here are different: the site should be shaded and very humid. Fruiting-body formation begins around the autumn season when the ambient temperature reaches 12-20 °C.

The inoculum is prepared by isolating the fungus in a pure agar culture and then transplanting to sawdust previously sterilized in an autoclave. The sawdust shortly becomes colonized. This inoculum may be kept in a refrigerator at 6-7°C to slow down further fungal development and fungal deterioration. The cultivation has the advantage of being practicable outdoors (Ito 1978). Under controlled conditions, however, production may be continued using the same logs up to six years.

CULTIVATION OF AURICULARIA AURICULA-JUDAE

In the East, this is regarded as a choice table mushroom. It has as extremely wide distribution. The fungus belongs to family Auriculariaceae. It is not a common cap-mushroom. The fruiting body is about 3-8 cm wide, smooth, elastic, slightly gelatinous, ear-like in shape: a rudimentary stipe may or may not be present. It is olive-green, brownish, purplish in colour. The flesh is elastic. The spores are colourless, cylindrical, smooth, and 12-17 x 4-7 µm.

The mushroom is still cultivated using rudimentary decomposing tree trunks (Cheng and Tu 1978). It seems to thrive on *Sambucus nigra* but may grow on other broad-leaf species as well. Fruiting-body sections are simply inoculated in the trunk crevices and incubated in the trunk crevices and incubated at 20-24°C in humid conditions. Production is relatively modest.

CULTIVATION OF PHOLIOTA AEGERITA

On of the best known by mushroom pickers, this fungus is valued for its flesh and excellent preservation. It is found in practically all European broad-leaf forests.

This fungus belngs to the family Agaricaceae. The pileus is 3-10 cm in diameter: hemispherical at first, then plano-convex: the surface is light tawny to dark brown, slightly shaded on the margin. The gills are ochre-brown. The flesh is firm, white, tending to brown. The stipe is 3-15 cm high and 1.5 cm wide:

slender, sinous, firm and dense, whitish-coloured tending more or less to brown. Annulus is fleshy and persistent. The spores are ochre-brown in mass, elliptical, and measure 8-11 x 4.5-5.7µm.

This mushroom is easily grown on poplar tubs outdoor, or in greenhouses. When cultivated in greenhouses, the ambience should be well-lit (without direct sun rays), and maintained at elevated humid it. It seems to prefer almost dead tree-trunks.

The inoculation may be affected by using either fruit body fragments or spores on the natural substratum. The spores should be used in water suspension. The mushroom may also develop on wood fragments (preferbly poplar) moistened and placed in plastic bags, as previously described for *Pleurotus ostretus* and *P. eryngii*.

CULTIVATION OF PHOLIOTA MUTABILIS

Like the previous mushroom, this species is common all over Europe. In relatively hot sufficiently humid climate, fruiting-bodies occur all year round, on decomposing tree trunks of various species. This mushroom is easily confused with *Armillariella mellea* and some *Hypholoma* toxic species.

This fungus belngs to the family, Agaricaceae. The pileus has a diameter of 4-8 cm, flesh, convex, rather than plane, slightly umbilicate, smooth and noist, with brownish colouring. The gills are yellowish than cinnamon-brown. Flesh is white. The stipe is 3-5 cm high and about 0.5 cm wide hollow, slender, coloured like the cap. It has anannulus and is scly at the base. The spores are oval, yellow-ochre in colour, 6-8 x 4-5µm.

The same cultivation techniques as described for *Pholiota aegerita* are valid. Its valuable characteristics merit more research on growth in media and controlled conditions.

CULTIVATION OF PHOLIOTA NAMEKO

Among the wood-attcking fungi *P. nameko* is one of the most cultivated in Japan alng with *Lentinus edodes*, *Flammulina velutipes*, *Pleurotus ostreatus* and *Volvariella volvcea*. Nameko refers to the viscosity of the cap which distinguishes the species. This characteristic, in addition to it appetizing aroma and flavour, makes it a choice delicacy in Japan. It is common on dead broadleaf tree trunks but its distribution seems associated with *Fagus crenata* on which it grows well.

This fungus belongs to the family Strophariaceae. The pileus is convex than plane at maturity: hazel-brown at the centre and lighter at the edges. It is covered by a mucilagenous substance and measures 15 cm in diameter. The gills vary in length white or yellowish then tending to rust-yellow or yellow-ochre. The stipe is central, 3-7 cm high and 2 cm wide, presents an annulus and its colour is lighter than that of the pileus. The spores are elliptic, truncate at the apex and measure 5-6 x 2.5-3µm, yellow-ochre or dark brown coloured in mass.

P. nameko may be cultivated on broad-leaf trees or conifer sawdust, sawdust from Fagus crenata, Quercus acutissima, Q. serrata, Carpinus, Castanopis, Cornus, Celtis etc., are particularly rcommended. An addition of rice husks is suggested. The mixture should be abundantly dampened. Temperature is also important and depending on the strains used, should range around 19°C for best development. Light also determines fruiting-body production, a lack of which causes malformation. Stuffy air rich in carbon dioxide inhibits growth. Thus, the mushroom requires ventilation. The inoculum is eaily prepared on common agar artificial medium with a peptone base. The pure culture is inoculated an the sawdust of previously sterilized bottles and the colonized substratum then inoculated on the sawdust bed of large cases.

CULTIVATION OF ARMILLARIELLA MELLEA

This common Europen mushroom, valued for food and preservation in oil, grows on broad-leaf and conifer tree-trunks, forming fruiting-body bunches, sometimes in abudance.

Many authors consider it a parasite of forest plants. The fungal hyphae, gathered in rhizomes upto several cm thick, penetrate between the bark and wood provoking considerable alteration. Its pathogenesis, however, is probably most seriously manifested on the plant's root system. Other authors consider it capable of invading only worn-out plants and those already infected by other pathogens. Still others, consider it as a saprophyte able to attack only dead plnts.

It belongs to family Agaricaceae. The pileus is 4-7cm in diameter; hemispherical than plano-convex, slightly unbonate, more or less intense tawny-yellow, brownish, greenish grey, redish brown, with small brownish scales in the middle of the surface. The gills are whitish, then becomes yellowish, brownish, or present dirty strains. The flesh is white and firm. The stipe is 5-15 cm high and 1-3 cm wide: its flesh is firm and fibrous. The colour varies from brownish to yellow-brown. The annulus is big, persistent, strite and whitish. The spores are white in mass, elliptical and 7-10 X 5-7µm.

It is easily cultivated on common agar media. Agar cultures may be inoculated on trees in poor conditions, reaching the wood by cutting the bark at the base. The mushroom rapidly colonizes the host tissues and then develops abundant and characteristic clustered fruiting-bodies. Results of attempts to cultivate on controlled organic substrata are not known.

CULTIVATION OF TREMELLA FUCIFORMIS

Since 1500, T. fuciformis has been recognized in China for its healing properties. The Chinese however, consider it more as a food source and indeed one of the most delicate which nature offers. It is also a wood attacking fungus and grows well on dead trunks and branches of many trees.

It belongs to the family Tremellceae. The fruiting-body has a series of lobed gills with recurved margins. Each lobe measures 5-15 x 4-12cm: the consistency is gelatinous. The basidiocarp underside enlarges into a yellowish haploid layer that invades the tree bark. The basidiospores are subglobose, 4-7.5 x 6.8-11.6µm.

It is saprophytic, distributed widely on a number of tropical species. Inoculum preparation is one of the most important aspects of its cultivation. It thrives on agar medium but isolation of aseptic sections is difficult. Pure culture is inoculated on moistened sawdust containing 20% rice husks previously sterilized in an autoclave. The mixture is incubated at 24°C until colonised, the kept at 15°C for 2-3 weeks before inoculating the substratum. The latter is composed of broad-leaf tree fragments. An early bark detachment, from the wood used for the substratum must, however, be avoided to impede contamination of other fungi. The wood should be sufficiently moist to favour fungal growth.

After inoculation, the trunks are placed in the laying yard where the mycelium develops. Growth and above all wood prepartion are essential for an abundant production. Sufficient humidity of the laying yard guarantees a good colonization, while excessive humidity favours the development of competitive fungi and parasites. The temperature of the laying yard should range between 20-25°C. The optimum temperature is 22°C.

The tree-trunks in the laying yard should be placed in a vertical, a lightly inclined or criss-crossed position to permit proper fruiting, air-circulation, and space utilization. The trunks become colonized within 35-45 days. Thereafter, the trunks are transferred to the raising yard as the fruiting-body requires an increase in moisture. Humidity is raised to 80-85% by frequent watering. The temperature should also increase to 22-27°C. Fruiting begins nearly two months after inoculation and continues for 7 months. The fruiting-bodies are easily dried, and prserved.

CULTIVATION OF STROPHARIA RUGOSO ANNULATA

It has been cultivated in Central Europe, especially in the German Democratic Republic and Poland, for many years.

It belongs to family Agaricaceae. The pileus is 4-10 cm: the surface glossy but not moist: colour varies from dark yellow to cream to brown to brick red. The veil shreds may remain on the pileus, later becoming whitish spots. The veil is white and filamentous. The flesh is white and the gills, violet-grey in colour. The stipe is 15cm high, dense and white, Large striped ring is white. The spores bear a germinative pore, are dark violet-brown, 10-12x 6.8µm.

The mushroom grows well on a simple grain substratum. The straw should be whole, i.e. unaltered by fungi, well washed and contain 70-75% humidity. This is obtained by soaking the straw in water for 48 hours. The excess water is drained, the straw is placed in beds, in about 25 cm deep layers which are pressed and the fungus is then inoculated.

The inoculum is obtained from fungal spores, aseptically isolated on artificial agar medium. The mycelium is then transferred onto ground and sterilized straw in Roux bottles. Once colonized (from 5-6 weeks at 26°C in a thermostat), the straw may be used to inoculate the bed (500 g inoculum per 1.5 m of bed culture). The inoculum is distributed as early as possible on top of the straw and covered with another layer of ground straw 5-6 cm deep. Within 3-5 weeks, the substratum should be entirely colonized and should be covered with 5 cm of soil. This cover determines the transformation of the mycelium from the vegetative phase to the reproductive phase. Sieved soil, possibly obtained from broad-leaf or conifer woods is recommended. Otherwise, a mixuture of humus soil (caleareous) at 30-50% peat moss is recommended. This last layer must also be moistened to 70-75% saturation and sterilized either with heat or layered in pits with 40% formalin. Humidity must be maintained by daily watering. Production begins within a week and lasts for several months.

To reach a significant production, S. reguso annulata requires particular environmental conditions. The artificially or naturally heated growing areas should reach a temperature of 24-27°C. A temperature below 20°C blocks the formation of fruiting-bodies, while one above 30°C exhausts the mycelium in a short time, favours infection and diminishes production. Substratum humidity is also important and should remain above 70%. It should be regulated by openings which avoid vapour condensation on the substratum.

SIGNIFICANCE OF EDIBLE MUSHROOM TECHNOLOGY TO ENVIRONMENTAL EDUCATION

The importance of edible mushrooms as a source of protein for the developing countries is very significant. The substrates for their production are easily available and the techniques of production of several edible species could be conveniently integrated in the farming practices of the rural farmers. The spent compost after mushroom production is a good manure. It has been observed that the transfer of the mushroom production technology to rural farmers may take many years, sometime decades. There is no doubt that the incorporation of waste management practices for mushroom production in secondary school curricula would hasten the process of technology transer in this sector.

The case of India could be usefully used to illustrate the point. There are several specialised laboratories doing R&D in mushroom science such as those at the IARI, Delhi, Solan and Srinagar. Over 200 scientists are engaged in this field all over India. Yet the total production of edible fungi in India does not exceed 1,500 tons. Since the technology of mushroom production is quite simple for several of the species and since production of this commodity does not compete with fertile land utilization, it would be of paramount importance to introduce this technology in environmental education to increase the awareness in this area and as a result protien production for human consumption.

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EVALUATION AND MONITORING OF ENVIRONMENTAL EDUCATION PROGRAMMES WITH REFERENCE TO ENERGY ISSUE IN DEVELOPING COUNTRIES

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INTRODUCTION

The concept of Environmental Education grew as a result of the environmnental movement that gained strength during the 1960s and 1970s. The widening of the environmental movement gradually brought three developments of major importance:

1. Scientific and nature protection components grew together under the influence of professional ecologists.
2. Appreciation of the environment grew in many countries outside Europe and North America.
3. The character of the approach to environment changed leading to a much broader concept of the natural environment: land water, minerals, all living organisms and life processes, atmosphere and the climate, polar ice caps and the remote ocean deeps and to the human situation both at the level of whole communities and the individual needs for housing and living, and emphasised the relationship between man-made and natural environment.

This third development had a broader and scientifically more sophisticated perception of the relationship between man and environment. It did not restrict itself only to the earlier nature protection movement but went beyond it and became concerned with technology, social organisations and in particular, with the way the population influenced the use and conservation of natural resources on the ground that the violation of ecological principles had reached the point where, at best the quality of life was threatened and at worst, the long-term survival of humanity could be imperilled.

The UNESCO and the U. N. Environment Programme developed an international environment education programme which aims at promoting exchange of information and experiences in the field of environmental education. Environmental Education courses were designed from primary to university levels. But the courses and the educational approaches differed in each country as the environmental issues were different. At the beginning the courses in environmental education were not very popular. The interest seemed to grow from the year 1979. These courses in developing countries because of the lack of employment opportunities. Public participation in evnvironmntal issues and environmental awareness increased mostly in wealthier and better-educated populations, and were stimulated by books and films as well as newspapers,

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Institute of Science, Education and Culture, Calcutta-17, India magazines and the eduation media. People's attitude towards environmental issues also changed. While remaining much concerned about pollution, they became more alert to the scarcity of resources, the necessity of conservation and the relation between environment and development.

In developing countries, environmental eduation needs to be planned nationally. Piecemeal perceptions of the environment are to be replaced by more comprehensive views due to the visible impact on environment of the fast-growing populations, high-intensity agriculture, introduction of modern transport systems, increasing demands for energy, and industrialization. To achieve this, constant evaluation and monitoring of environmental education programme are necessary.

Goal of Environmental Education

The principal goal of any environmental education programme should be to develop:

a. awareness of and sensitivity to the total environment and its allied problems.
b. knowledge of the total environment, its associated problems and the responsible presence of humanity in it.
c. attitudes, social values and strong feelings of concern for the environment, and motivation to participate in its protection and improvement.
d. participation to infuse a sense of responsibility and urgency regarding environmental problems so as to ensure appropriate action to solve them.
e. skills to solve environmental problems
f. ability to evaluate environmental measures and education programmes in terms of ecological, political, economic, social, aesthetic and educational factors.

ENVIRONMENTAL EDUCATION, EVALUATION AND MONITORING

The methods of environmental education, its evaluation and monotoring process can be divided on the basis of the potential areas into three following categories:

1. Formal Environmental Education, Evaluation and Monitoring for students through academic process.
2. Semi-formal Environmental Education, Evaluation and Monitoring for policy-makers, executives and administratorw through orientation programme.
3. Non-formal Environmental Education, Evaluation and Monitoring for rural people through field service.

The first category is primarily meant for the vast group of students at all levels who will assume responsibilities in course of time. The approach to such programme should be top-to-bottom in the context of global picture and national goals. The second category is meant for the people who are at present taking decisions, executing the plans and programmes in all spheres of life. This should be a combination of top-to-bottom and bottom-to-top approach. The third category is meant for the people in villages, the vast majority of whom are farmers, wage-earners who are mostly poor and illiterate. This approach should be from bottom-to-top. In the third category, evaluation and monitoring process have been exemplified with special reference to energy problem. However, all environmental problems for the rural people may be handled in the same manner.

Formal Environmental Education, Evaluation and Monitoring

The evaluation and monitoring system of environmental education should be based and developed on the basis of goals broadly stated above. In cases where environmental education has been introduced, it is really difficult to evaluate the actual changes that have taken place in the curricula of different education systems, classroom teaching methods and teaching materials and their effects upon students. But there is enough evidence indicating the involvement of common people in public decisions concerning environmental quality.

The environmental education at the pre-primary and primary levels should concern with group activities. Some informal training should be given in personal hygiene, and problems of food and water contamination. Formal environmental education has been introduced as a subject in primary school curricula in some developing ountries.

Students at the secondary level are usually receptive and strongly moivated, and are capaable of assimilating environmental education that is value-oriented, community-oriented, and concerned with human well-being. Experimental and field studies may be included as a apart of the secondary school environmental education programme. The secondary school environmental education programme. The secondary school courses should emphasise out-of-school activities, problem-solving and communty activitis related to environmental problems and should concentrate on basic environmental facts such as ecology, resource distribution, population dynamics, and problems of hunger and starvation. At the secondary level, one additional subject such as Mathematics or Biology is taught. Among such optionals one subject entitled "Environmentology" (Environmental Sciences) may be included. General curricula have also to be developed in all subjects fitting environmental issues wherever suitable.

In particular science subjects while treating a topic or chapter, the related environmental issues are required to be stated just as the experiments, illustrations, derivation of formula and applications are treated under distinct subtitle. Similar procedure may be adopted also in the humanities. Questions also must be set from environment topics regularly in the examination to make its study effective. The university-level education is largely aimed at filling job vacancies; the higher education system has, therefore, to be narrowly vocational. Many universities may however, offer courses that aim at promoting environmental awareness, and there is a trend towards increasing these types of courses. Subject matter or environmmental education is to be grouped under broad topics such as energy, ecology and social systems to reduce the fragmentary nature of the course. Postgraduate education in environment in several universities in developing countries should offer courses in:

1. environmental planning and resource development
2. environmmental impact studies
3. teacher training
4. ecological disturbances and environmental degradation
5. system analysis and operations research techniques for environmental systems
6. investigation of various pollutants and exotic agents

Even in the first Degree Course one combination paper on 'Environmentology' may be introduced by the universities on the same footing as Physics, Chemistry, Biology, Psychology, Education, Sociology etc. For this, appropriate curriculum has to be developed and books are to be written.

At Master's Degree level a provision may be made to study environment in more details.

In employment also, weightage should be given to the candidates with knowledge and experience about environment.

At the professional level such as Law, Medicine and Engineering also, environmental education has to be introduced. The major aim of environmental education at this level should be to develop specialised knowledge and technical skills in students on environmental issues.

Lawyers are increasingly assuming a role in environmental issues. Appropriate courses should be introduced not only to protect environmental laws but also to create awareness to the needs of introducing modern laws.

In all branches of engineering suchas civil, electrical, mechanical, chemical, metallurgical, rubber and plastics, appropriate environmental issues related to the discipline concerned should be introduced. However, in many universities Environmental Engineering courses have already been introduced.

Just as a medical student has to study Jurisprudence at one stage of the course, he should also study a short course on Environment related to the medical field. Such a course has to be properly designed and developed.

At polytechnic level a suitable environmental course has to be provided in the curriculum.

Environmental education programmes are to be introduced for both in-service and pre-service training of teachers.

Semi-formal Environmental Education, Evaluation and Monitoring

It is well-known that in the implementation of national plan and programme, the policy-makers, executives and administrators play a vital role. It is, therefore, necessary to educate such groups of people in the environmental issues. The approach to this education should be from the top-to-bottom in the context of national goal on one hand and from bottom-to-top from the standpoint of common man on the other. Administrators, executives and policy-makers of all national and state establishments, autonomous organisations, private and public industries and the like should get environmental education.

The programme of education may be of short duration ranging from one day to a few weeks regularly instead of a long duration at one stretch. It may include short courses, workshop, seminar with field trips and problem-sovling sessions. The course should be designed with specific objectives to identify and solve environmental problems such as energy issue, pollution, family planning, health, transport, etc., especially related to individual organisations.

Executives down from block level through district level to state level must get education on environment, and especially on the methods of nonformal education problems of the rural people.

Officials can bring their problems to such orientation programme for discussion, suggestion and solution, broadly speaking for making interactions with other participants.

It may also be noted that the betterment of employment position of such officials should be tagged with the nature of their involvement in the environment programme of the organisation concerned.

In this connection it may be noted that every industry has a Safety Department and Inspectors visit the industries to check if the safety measures are strictly followed. Henceforth such Safety Departments may be entrusted with environmental issues or such departmnts may be renamed as Environmental Departments which include the functions of safety and must observe environmental issues strictly. An yearly award may be declared by the Government for judging the industries for maintaining best environmental conditions. Similarly punishments should also be there for violating environmental standards.

Nonformal Environmental Education, Evaluation & Monitoring

The environmental education for rural people is examined here with specific example of alternative energy use. The eudcation of the rural people is an extemely difficult task. To most of the people the idea of alternative energy system, say biogas is quite new. Even if they accept the idea, they may not practise it.

Rural Economic Structure

There exists great inequality among the rural population in developing countries like India. Consideration of such inequality spectrum is important in determining who can adopt new energy system such as biogas. Main property in rural areas is land. At the lowest level of inequality spectrumn are the landless having a hut to live and form the major labour force in agricultural or industrial field. There is a group above this landless possessing one or two plots of lands and a few animals. They also live mostly on their labour. At the uppermost level are the wealthy and powerful landholders possessing large number of animals. These landholders sometimes have moderately educated or well-educated children who take employment in the nearby developed places or towns. In between them there is a heterogeneous middle level group which possesses land, animals, small or medium size business or shops and has fairly-educated, employed or sometimes unemployed children. The upper level landholders often coordinate various groups and become very powerful in decision making.

In this broad inequality spectrum, the scope for the poorer to adopt any alternative energy scheme and benefit from it is rare, specially if it concerns financial, commitment. For that matter any environmental education in the lower part of the inequality spectrum, is hopelessly miserable. Control over the land and animal and other related material resources, financial ability and social influence are all in the hands of the people of the upper part of the inequality spectrum. It is, therefore, these groups who can adopt any alternate energy scheme such as biogas system when they get proper education. It may incidentally be mentioned that it is these groups who have taken advantage from governmental plans meant for the poorer section in the past, making their relative position stronger and sometimes leaving the poorer section in more bad condition. Any environmental programme must keep this rural power structure in mind while formulating any scheme for the rural development.

Perception of Energy Problem or an Environmental Issue

With deforestation, nutrition depletion, population growth and the imbalance of ecosystem- energy problem of the poor is very clear to the scientists and policy-makers. But this perception cannot be clear to the populations in general who are affected by this problem. The poor can collect fuel in one form or the other, sometimes free of cost, sometimes at a minimum cost without being aware of or caring for the environmental problems including energy issue. Even if they are made aware of the energy problem, they will not show or are not in a position to show interest as they have more immediate problems such as working for food. The near-landless farmer when able to collect some money will purchase an animal or a piece of land or both than to spend money to build biogas digester. It is not possible for them to realise the long-term benefit. The wealthy section of the rural population can only have the means to provide money for any new energy system when they are properly educated and made aware of the entire situation and are made sufficiently motivated. This is the same situation for any other environmental issue.

Tradition

Traditions are very important in the behaviour pattern of mankind in general. Traditions are deeply rooted in the way of life, especially of rural populations. They play vital role in the cultural integrity of the community. It is very difficult to introduce anything alternative contrary to the traditional practice. Changing the traditional practices even by law may lead to many bad effects. Therefore, any new schemes must be extremely attractive and yet the habits may change very slowly. Again, the upper-level rural people who have educated children employed in towns and interact with the outside are rather likely to change the habits more quickly. However, the tradition effect must be considered in the education programmes.In India, the use of cow dung for biogas generation may however not find obstruction. Cow dung is extensively used in rural India and is considered sacred. But the use of human excreta will be vehemently opposed.

Cost and Benefit

People take a decision on a specific matter and practise it on the basis of cost and benefit therefrom. Again, there are variations in the cost-benefit approach in various rural economic groups due to variations of resources and the benfit threby returned. One of the major problems concerning alternative use of energy is that long term and indirect benefits are not perceived by an individual in rural area and are sometimes covered by immediate return.

Another aspect in introducing a new energy scheme for cooking porcess is the role played by women in India. Women are primarily involved in collecting or selecting fuel for the cooking process. It is their opinion in the matter of cooking with a particular fuel that plays decisive role in the family. Generally their role has to be considered in all rural environmental schemes.

Implementation Programme

For rural people, all environmental issues for development such as irrigation, transport, agriculture, population control, forestry, nutrition, health, sanitation, etc., are to be tied together and efforts should be given in a package in entirely nonformal way.

In order to make a programme successful for rural development, the bottom-to-top approach has to be followed. In the bottom-to-top approach people's needs are assessed by the people themselves and not by an external agency. This is possible only when people are educated to perceive the problem. However, this is not easy to achieve. It concerns helping the people to solve their own problems. Ineffectiveness in many of the government rural plans is due to the top-to-bottom approach in which case people's needs are estimated by an outside agency sitting in a distant room, even sometimes never visiting the locality and the people for whom the programme is prepared. That is why, people's participation and response to the development programme have not been available in the past. Only a few from the upper level who are always searching for an opportunity from the government plan, get the benefit.

In order to implement a programme, there should be Rural Development Centres or Community Centres around several villages where demonstration of the biogas system and explanation of other environmental issues such as health, sanitation, population control should be conducted. The participation and training of local people in such centres are to be organised.

In the bottom-to-top approach Field services/Community services/Environmental services have to be created. These service people should conduct the community centres and liase with the people at the bottom on one hand and with administrators and policy-makers on the other, and monitor the environmental programmes including energy issues.

There should be women in this service cadre and local women should also participate in the nonformal education and training scheme.

The Field service people together with the local trained people should visit different localities and record informations on the traditions, habits, economic conditions, customs of fuel collection, nature of fuel used and environmental issues for people of each economic stratum. They should also study the constraints for use of any alternative energy source or adopting similar environmental programme. Attempt should be made to create the perception of energy problem in the peple of each economic level. Women in the family should be directly contacted during such visit and their opinion should be given weightage.

The above may form the first phase of energy education or environmental education scheme. However this should be the continuous process and constant interaction with people is necessary. In the second phase technical aspects have to be considered. All such information should be communicated to the administrators, and policy-makers for the latter's appraisal and policy formulation and also monitoring the programme. In each zone around the centre, technical facilities for building alternative energy system has to be searched. If this is not possible, the centre itself should develop them. Even the improvement over the existing cooking stoves in respect of efficiency and economy for heat production has to be considered for the people of lower strata who will not be in a position to switch on to any alternative system. When people are accustomed to the use of an improved cooking stove, they may be further induced to the use of more improved cooking system. This is also the method of changing the habits of the people in slum areas and of improving the physical conditions in the slum.

Repair and maintenance of the new energy system plant have also to be arranged in the local place and if this is not possible it has to be done in the centre itself at the beginnig,.

In the third phase,crdit system from the local bank or from the government agency have to be studied and for each economic level this is to be appropriately decided so that people when motivated can swtich on toi new energyy system with the financial help. Finance system should be checked and aranged such that people of lower economic group get maximum benefit.

Government agency has to assess from time to time the nature of progress made in the programme and check, control, modify and orient the programme for improvement of the entire process.

Environment Centres should be run such that it can create employment for the local people: nominally educated boys and girls, local craftsmen, semiskilled or unskilled workers. Thus, the entire programme should generate also employment. Such local employment opportunities will also help in introducing environmental education in the locality.

It is likely that the upper level rural people having educated service holders will accept the new energy system more quickly. In every locality there are persons who are well-respected or who are taken as models by many local people. Such persons are to be inducted first to accept the new energy system or other environment programmes. If a few families in each economic stratum are initially induced to accept the new energy system or follow an environment programme, it will gradually induce other families in the corresponding economic group.

CONCLUSIONS

Finally it may be stated that for effecive implementation of any environmental programme or for introducing any new energy system there should be a variety of approaches some of which are stated in the text. The implementation effort should be based on appropriate evaluation and monitoring activities related to the following general pre-conditons:

1. Appropriateness: any environmental system or energy system should be apprpriate for the local conditions.
2. Attractiveness: the system must be attractive to the potential users.
3. Affordability: the system should be affordable to a wide section of the population.
4. Availability: the system should be avilable along with the necessary informations and system back-ups.

These four A's should be remembered in handling enviornmental problems.

In developing countries, the basic requirements like food, clothing, shelter and medicine for wide section of the population are needed to be fulfilled. Therefore, implementation of environmental programme would require long time. The progress will be very slow. It cannot be achieved by making a few patch works here and there. A systematic approach through every facet of life has to be initiated and sustained for long period of time with determination from those who are invovled in it.

INSTITUTION AND COMMUNITY BASED ENVIRONMENTAL EDUCATION

G.D. Kabra and Lalita Kabra*

Fast growth of population and industries is responsible for depletion of natural resources in later part of 20th century. A growing concern is being depicted by the mass media about various aspects of such problems like pollution of water and air, decay of natural surroundings and heritage, loss of wild life and so on. But the traditional outlook and practices as well as hard realities of life and modern civilization force the people to continue the activities which are harmful to the environment and to the future generation in the long run. Some concerned and imaginative groups have taken up the cause of saving the environment and creating awareness among the masses. 'Chipko' movement in Uttarakhand and recently its counterpart in Karnataka (Alvares 1984) are exemplary action programmes supported by women and youth. However there are large areas where such environmental awareness and efforts do not exist. Still a long way has to be covered for involving sizeable community to conserve the nature's gifts for future generations.

Certainly, environmental education cannot be spread only by mass media. There are the findings that any action or innovation is adopted at mass scale when the mass media publicity is supported by various local influentials and groups. Katz reported a variety of studies which indicates that people are not easily pursuaded to change their opinions and behaviour......influences from the mass media are intercepted by interpersonal networks of communication and made more or less effective thereby. In India and particularly with reference to environmental diversity, the effectiveness of mass media is also circumscribed by multiplicity of dialects/languages and location-specificity of our problems. Taking into consideration this limitation of mass communication for the environmental education for potentials existing at the level of various institutions and community organisation.

School as a Base

From various perspectives school is an important base centre for environmental education and action. Schools are established in all parts of the country. Millions of students provide an opportunity to spread the message of nature's conservation if

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teachers are properly motivated. If the younger generation assimilates the word and action in this respect, present and future programmes will gain momentum. The students may prove constructive links between environmental/educational institutions and the community, as has been witnessed in the tree plantation programmes of Bhartiya Agro-Industries Foundation near Pune. School students also participated enthusiastically in many schools of Gujarat for raising seedlings in their school premises under the guidance and help from the forest department.

Another important innovation may be attempted to give a big push to students' energy and imagination by developing a linkage system or nexus of schools in a micro-region. This may be based on eco-development awareness and action programmes. Nature clubs, innovative science teaching, cultural and aesthetic programmes and related innovations may be used for making meaningful integrated efforts and communication among a group of schools in a given micro-region. This will enhance the youthful imagination of the students, deeper understanding of the location specific problems and 'catching them young'for developing environmental concern. Certainly some supportive agencies, training and assistance are very crucial to materialise such nexus on micro regional basis.

The key figure in such an innovation is teacher. He has to be oriented and given an opportunity to interact with workers and experts in the field of environmental conservation. In fact, environmental education can be integrated into teachers' training programme. Already in some universities there is specialisation of population education in teachers training programme. Either this subject can be broadened or a specialization can be developed to include environmental education. Environmental Education can also be developed. National Council of Educational Research and Training which has already contributed much towards environmental education may assist the teacher training programme by developing appropriate course of study and motivation for the teacher trainees. Regional meeting and interaction of such interested and motivated teachers when arranged may further boost the cause of environmental education. All these efforts will also result in the form of mobilisation of youth for action-oriented projects.

Institutions in Rural and Tribal Regions

Another set of important institutions are panchayat, multipurpose cooperative society and Tribal Development Corporation. Though some of these field based organisations are mobilised under social forestry programmes, much potentiality remains to be tapped if inter-departmental coordination is achieved. In tribal region of Rajasthan the tribals are motivated and assisted by Tribal Development Corporation and Forest Department to plant trees on marginal land. During gestation period such tribals get financial assistance spread over three years according to the survival rate of the plants. In rural and tribal areas the biogas plants and smokeless energy efficient chulhas are also being subsidised. Some voluntary organisations in Udaipur district are also functioning as catalysts to popularise these programmes. Still there is scope that with the combined help of mass media and village based institutions; various aspects of environmental education may be taken up so that community is actively involved.

An effort to involve village institutions in Madhya Pradesh was made in the form of 'Project Harivali'. In this project treeles hillocks at various places were taken up for establishing forest where initial expenditure is provided by the government and coordination of various village institutions is sought for achieving the purpose.

Research Institutions and Industrial Houses

Various above mentioned programmes should be assessed with the perspective of involving village institutions and community. This will give a continuous support to environmental concern. In tribal region an action programme is essential in the view of depleting minor forest produce which are being exploited continuously without concern for their consrvation and sustainable development. Here, the role of research institutions is inevitable. This requires flow of communication between research institution and local community on one hand and amongst various research and extension institutions on the other. Priority has to be accorded to survey and research on minor fruits and monor forest produce which though economically or commercially may be 'minor' but they are important from the point of traditional uses and nutritional and medicinal applications.

Industrial houses also can play an effective role towards environmental development. A willingness is also expressed by Federation of Indian Chambers of Commerce and Industry (FICCI) in respect of drinking water supply system and sanitation in rural and backward region. There is an immediate need to integrate environmental programes with the local specific conditions. To achieve this, research institutions and integrated strategies on the basis of field studies and discussions with village institutions and community.

Cultural and Aesthetic Outlook

Indian tradition is rich with cultural and aesthetic perspective congenial to environmental conservation. Sacred groves around shrines and religious places are found and protected. There is richness of citation of various plants and creepers in the poetry of great Sanskrit poet Kalidasa. Even a park is being established where all the vegetation cited in the poetry of Kalidasa will be found. There are numerous local traditions of the worship of sun, trees and forest deity, some such traditions are used by institutions and movements to inculcate the awareness and importance regarding environment and eventually active involvement of the community in conservation and enchancement of the richness of the local environment. Some innovative environmental programmes on these bases may be developed so that 'an environmental bias permeates into all facets of one's life' rather than making it merely a departmental activity or a separate subject of study.

Network of Community Centres

If a closer look and cooperation is sought in various traditional and local situations vis-a-vis newly established development departments and non-governmental organisations, there is sufficinet scope of seeking the participation and involvement of the persons belonging to different age groups and occupations. Environmental education, to be effective and result oriented must tap and involve the people in tribal, rural and urban areas. Limiting the emphasis on the use of mass media alone for environmental education will not be much fruitful as communications from the mass media are not directly effective on most members of the 'mass' but rather have an effect only after they have been transmitted or legitimized by local institutions, leaders and grass-root workers.

It would, therefore, be in line to develop community environmental centres at micro-regional level to maximise the effectiveness of various innovative environmental programmes, linking efforts of various educational and implementing agencies and exploring further avenues and potentialities in their area of location. These community centres involving interested experts, social workers and eminent citizens and the school clubs mobilising the younger generations's participation in various environmental projects, can be federated at macro-regional level, thus creating a network to provide mutual encouragement, richness of experience and active support for the cause of environmental concern and action.

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KNOWLEDGE, ATTITUDE AND PRACTICE OF FAMILY PLANNING IN A HARYANA VILLAGE COMMUNITY

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India, a developing country, has 2.4 percent of world's land where 15.5 percent of the world's population resides. A baby born after every one and a half second adds twenty one million children in India every year which is equivalent to Australia's population. If the current state of affairs continues, all the achievements accomplished so far as a result of planned development efforts would be nullified. Even from a purely economic standpoint, expenditure on population control is one of the most profitable forms of investment for India (Huxley 1959).

This problem was recognised in early fifties and as aresult of it family planning programme was started by the Government of India in 1952. Till 1963, the approach was clinical and afterward extension education approach was followed and a separate Department of Family Planning was created in April 1966. A comprehensive population policy was enunciated only in April, 1976 and family planning programme continued to retain its position as one of the major national priorities. But the appealing fact is that inspite of various inputs in terms of finance, men and materials, the fertility rate continues to be relatively high.

Human fertility behaviour is conditioned to a large extent by a set of social, economnic and psychological factors (Pareek and Kothandapani 1969, Kotagiri and Tearo 1972, and Burman 1973) but little attention has been paid so far to these aspects. Moreover, for longterm assessment and planning such vital information is necessary (Seal 1977). With these aspects in view, this micro-level empirical study was conducted in 1981-82 with the folloowing specific objectives:

i) to assess the knowledge, attitude and practice of family planning in a village community;

ii) to trace out the relationship of different scio-economic and personal factors with knowledge, attitude and adoption of family planning.

METHODOLOGY

The present study was conducted in village Nalwa of National Extension Service Block Hisar of Haryana State. In the village, there were 300 eligible couples. Of these 100 couples were selected with random sampling procedure. Among selected couples, males were administered a pretested structured respondent schedule containing questions pertaining to research objectives.

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Knowledge and attitude towards family planning were measured by scales developed by Balakrishna (1974) and Katakwar (1972) respctively, after making necessary modifications. Practice of family planning was measured by dividing the number of years a couple was using family planning measures by the number of years for which they were eligible to adopt these devices. Trivedi's (1963) scale was used, after updating, to convert attributes like caste and occupation in quantities for discerning correlation where real and all values are being used.

Scores obtained on knowledge scale were divided into three categories in order of magnitude. It was done by arranging the scores in a descending order and dividing into three equal parts with higher and lower limits of respective categories. Same procedure was adopted for categorising respondents in attitude and adoption categories.

RESULTS AND DISCUSSION

Knowledge, Attidue and Adoption of Family Planning

Majority of the respondents (72%) had moderate level of knowledge (score 5-7) of family planning which was primarily due to the efforts by the State and long span of diffusion of this innovation. Only 7 percent respondents had low level of knowledge of family planning.

Favourable attitude towards family plnaning was found among 66% respondents and unfavourable attitude among 4% respondents.

Majority (53%) of the eligible couples were in low level of adoption of family planning practices followed by high (30.5%) and medium (16.5%) categrories.

It is inferred that respondents had fairly high knowledge and favourable atttitude but comparatively lower adoption of family planning practices and there is much scope for adopting persuasive strategy for accelerating adoption process. The association of different independent variables with the level of adoption of family planning is discussed below (Table 1).

Age

The attitude towards family planning was higher among middle age group (26-30 years) respondents followed by the youngest (upto 25 years) and the eldest (above 30 years) age group respondents. Age was not significantly associated with knowledge and attitude. Kulhari et al. (1972), Mukherjee (1973) and Kaur and Singh (1982) also found no association between these variables. Findings of Aggarwal (1961) and Bhatia (1970) that higher age was more conducive to knowledge of family planning is supported by positive relationship discerned in the present study.

Table 1. Relationship (r-values) between different variables

Independent variable	Knowledge	Attitude	Adoption
Age of the respondent	0.163	0.128	-0.096
Exposure to information sources	0.390**	0.280*	0.280**
Caste of the respondent	0.222*	0.160	0.101
Education of the respondent	0.497**	0.482**	0.320**
Main occupation of respondent	0.423**	0.392**	0.321**
Annual income of family	0.311**	0.258**	0.102
Knowledge about family planning	1.00	0.580**	0.638**
Attitude towards family planning	0.580**	1.00	0.580**

* Significant at P= 0.05 ** Significant at P= 0.01

Adoption of family planning practices decreased with increasing age and the association between variables was negative and non-significant as also reported by Kaur and Singh (1982) in a study of women.

Exposure to Information Sources

There was a positive and significant association (P= 0.01) between exposure to information sources and knowledge, attitude and adoption of family planning. Kaur and Singh (1982) also made similar observations.

Caste

Caste status in the society was positively and significantly associated (P= 0.01) with knowledge about family planning but non-significantly with attitude and adoption of practices. Bhatia (1970), Kulhari et al. (1972) and Kaur and Singh (1982) also reported that higher caste status is conducive to family planning but not significantly associated.

Education

Positive and significant association (P= 0.01) was found between education of the respondent and his knowldge, attitude and practice of family planning. It might be because of greater exposure of educated person to outer world, higher preference to small family and urge for knowledge. Aggarwal (1961), Bhatia (1970) and Mukherjee (1973) invariably found positive and significant association of education with knowledge and attitude towards family planning. Punia (1981) and Kaur and Singh (1982) reported education as a contributory factor in adoption of family planning practices.

Occupation

Respondents from higher status occupations had better knowledge, more favourable attitude and higher adoption as compared to those from lower status occupations and the association was significant (P= 0.01). Mukherjee (1973) had observed significant association with knowledge and Punia (1981) and Kaur and Singh (1982) with adoption of practices.

Income

Annual income of the household was positively and significantly asssociated (P= 0.01) with knowledge and attitude towards family planning. Similar were the findings of Bhatia (1970), Mukherjee (1973), Punia (1981) and Kaur and Singh (1982). Income was not significantly associated with practice and majority of the highest income group people did not like to practise it.

Knowledge

It was significantly correlated with attitude and adoption of practices. Kaur and Singh (1982) also found knowledge of family planning as the most important and highly contributing factor in acceptance of family planning practices by rural women.

Attitude

With higher knowledge, the attitude was more favourable and so the adoption of practices. Their association was highly significant (P= 0.01).

Reasons for Adoption of Family Planning

Among majority (76%) of acceptors of family planning, the need to limit the size of family in increasing economic hardship was the major motivation. Khare (1965) puts the same as independent action towards family planning occurred among educated and economically sound people as they had learned to act indpendently and among those who had made to see the relationship between too many children and their own property. Thus the economic reason was the major motivation for adopting fertility control measures specially in the families with middle income and educted members.

Reasons for Non-adoption of Family Planning

Among the non-adoptors, a large majority (64%) did not feel its necessity primarily becuase a large number of respondents were below the age of 25 years and a few around middle fourties. Lack of knowledge about control measures was given by 6% of non-adoptors only. Mukherjee (1973) also reported same for another village of Haryana. That the use of contraceptives affects health adversely, was given a reason for not using it by 30% respondents (Kulhari et al. 1972, Mukherjee 1973), and 26% reported dissatisfaction of married life. In both cases, the majority comprised of illiterate males from agricultural occupation. Opposition from elders and restriction of social values was also reported as barrier in adoption by 22% of non-adoptors. Khare (1965) also reported religious values and mother-in-laws' roles in adoption of family planning in north India. High price of techniques as a barrier in adoption was considered by about one-fifth of non-acceptors. Non users (22%) from lower income group, lower caste and lower education put forward the economic reasons like lower cost of bringing up of the child, additional income earner to family and economic security for old age, as the reasons for not adopting the family planning measures. Respondents from very high income group with low level of knowledge also considered child as an economic asset.

IMPLICATIONS

Family planing is more a family goal, being affected by social and economic status in the community. Economic reasons are more responsible for the adoption behaviour than others and: these are again centred around the family institution. Old age security, specifically to poverty riddled sections, would contribute a lot in accepting family planing and taxing rich for additional child would curb their tendencies. All this needs a strong political will to frame and implement approprite legislation. Steps taken at this stage may prove disastrous for India's development.

Future of family planning programme is optimistic but to hold responsible one factor for it would be mileading. Inequalities are inbult in this social system which largely affect the social, economic and psychological makeup of the individual which in turn accelerate or retard the adoption of family planning. A field theory approach would be most suitable for studying this problem and formulating measures to popularise the practice among masses.

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